National Advisory Committee for Aeronautics

Research Abstracts

NO.57 JANUARY 29, 1954

CURRENT NACA REPORTS

NACA TN 3050

A PHOTOGRAPHIC METHOD FOR DETERMINING VERTICAL VELOCITIES OF AIRCRAFT IMMEDIATELY PRIOR TO LANDING. Emanuel Rind. January 1954. 23p. diagrs., photos. (NACA TN 3050)

A photographic method which has been successfully used for obtaining statistical data on vertical velocities of land-based aircraft immediately prior to landing contact is described. A long-focal-length (40-inch) lens is used. No instrument installation on the aircraft or interference with airport operation is required. A relatively simple data reduction is employed.

NACA TN 3059

ELASTIC BUCKLING UNDER COMBINED STRESSES OF FLAT PLATES WITH INTEGRAL WAFFLE-LIKE STIFFENING. Norris F. Dow, L. Ross Levin and John L. Troutman. January 1954. 19p. diagrs., photos., tab. (NACA TN 3059)

Theory and experiment were compared and found in good agreement for the elastic buckling under combined stresses of long flat plates with integral waffle-like stiffening in a variety of configurations. For such flat plates, 45° waffle stiffening was found to be the most effective of the configurations for the proportions considered over the widest range of combinations of compression and shear.

NACA TN 3064

DATA ON THE COMPRESSIVE STRENGTH OF SKIN-STRINGER PANELS OF VARIOUS MATERIALS. Norris F. Dow, William A. Hickman and B. Walter Rosen. January 1954. 49p. diagrs., photo., 7 tabs. (NACA TN 3064)

Flat skin-stringer compression panels of stainless steel, mild steel, titanium, copper, four aluminum alloys, and a magnesium alloy were tested. The results show the effect of variations in yield stress, Young's modulus, and both yield stress and Young's modulus for constant yield strain on the buckling, and load-shortening characteristics of the panels.

NACA TN 3113

ANALYSIS OF STRAIGHT MULTICELL WINGS ON CAL-TECH ANALOG COMPUTER. Stanley U. Benscoter and Richard H. MacNeal, California Institute of Technology. January 1954. 79p. diagrs., 4 tabs. (NACA TN 3113)

Using the Cal-Tech analog computer, structural analyses have been made for four straight multicell wings. Wings with aspect ratios of 2 and 4 with rectangular and biconvex cross sections have been considered. The wings are supported rigidly along two lines at the faces of the fuselage. Concentrated loads are applied at the intersection points of the ribs and spars. The effects of shearing strains in the ribs and spars are included. Deflections and all internal force quantities have been recorded as well as vibration modes and frequencies.

NACA TN 3116

CORRELATIONS INVOLVING PRESSURE FLUCTUATIONS IN HOMOGENEOUS TURBULENCE. Mahinder S. Uberoi, Johns Hopkins University. January 1954. 61p. diagrs., 2 tabs. (NACA TN 3116)

It is shown that the correlation of fluctuating static pressure (in an incompressible and homogeneous turbulence) with any fluctuating quantity in the flow field can be expressed in terms of the correlation of the same quantity with two or more components of the velocity. The correlations of pressure with itself and of pressure with two velocity components are investigated in detail for the case of isotropic turbulence. A postulated relation between the fourth-order and second-order correlations is investigated. The consequences of this relation are compared with the measurements of the fourth-order correlations. The root-mean-square pressure and pressure gradients are computed from second-order correlation for a range of turbulence Reynolds numbers. Since the pressure gradient is related to diffusion of marked particles from a source, the computed pressure-gradient level is compared with that calculated from a set of diffusion measurements. The triple correlation equation and plausible hypotheses relating higher order correlations with second-order correlation are examined for the possibility of getting a determinate set of equations for isotropic turbulence.

NACA TN 3118

DESIGN DATA FOR MULTIPOST-STIFFENED WINGS IN BENDING. Roger A. Anderson, Aldie E. Johnson, Jr. and Thomas W. Wilder, III. January 1954. 31p. diagrs., 3 tabs. (NACA TN 3118)

The results of a computational program are presented which give numerical values of the stiffnesses required of the various components of a multipost-stiffened wing to achieve desired buckling-stress values under bending loads. Two arrangements of the posts are considered, upright posts and posts used as diagonals of a Warren truss. This work extends and summarizes the calculations presented in NACA RM L52K10a.

*AVAILABLE ON LOAN ONLY.

ADDRESS REQUESTS FOR DOCUMENTS TO NACA, 1724 F ST., NW., WASHINGTON 25, D. C., CITING CODE NUMBER ABOVE EACH TITLE, THE REPORT TITLE AND AUTHOR.

NACA TN 3119

STATIC PROPERTIES AND RESISTANCE CHARACTERISTICS OF A FAMILY OF SEAPLANE HULLS HAVING VARYING LENGTH-BEAM RATIO. Arthur W. Carter and David R. Woodward. January 1954. 38p. diagrs., photo., 3 tabs. (NACA TN 3119)

The principal results of the investigation of the static properties of a family of seaplane hulls are presented in charts from which draft, trim, and upsetting moment may be obtained for wide ranges of load, center-of-gravity location, and angle of roll. Charts are presented for the determination of resistance and trimming moment for length-beam ratios of 6 and 15.

NACA TN 3120

SPAN LOAD DISTRIBUTIONS RESULTING FROM CONSTANT VERTICAL ACCELERATION FOR THIN SWEPTBACK TAPERED WINGS WITH STREAMWISE TIPS. SUPERSONIC LEADING AND TRAILING EDGES. Isabella J. Cole and Kenneth Margolis. January 1954. 62p. diagrs., 2 tabs. (NACA TN 3120)

On the basis of the linearized supersonic-flow theory, equations for the span load distribution resulting from constant vertical acceleration (i.e., linear angle-of-attack variation with time) are derived for a series of thin sweptback tapered wings with streamwise tips. The analysis is valid, in general, at Mach numbers for which the wing leading and trailing edges are supersonic. Computational results are presented in the form of generalized design curves which permit fairly rapid estimation of the load distribution for broad ranges of the parameters aspect ratio, taper ratio, leading-edge sweepback, and Mach number.

NACA TN 3121

SOME EFFECTS OF ASPECT RATIO AND TAIL LENGTH ON THE CONTRIBUTION OF A VERTICAL TAIL TO UNSTEADY LATERAL DAMPING AND DIRECTIONAL STABILITY OF A MODEL OSCILLATING CONTINUOUSLY IN YAW. Lewis R. Fisher. January 1954. 49p. diagrs., photos., 6 tabs. (NACA TN 3121)

A fuselage—vertical-tail combination with tails of two aspect ratios, each of which was tested at four fuselage tail lengths, was oscillated in yaw through a range of reduced-frequency parameter corresponding to the lateral motions of airplanes. The phase lag of the tail force was measured during oscillation and converted to damping in yaw to determine the effects of varying these parameters. A complementary theoretical analysis based on the finite-span theory of Biot and Boehnlein is made on the effects of tail length and aspect ratio on the unsteady lateral damping and directional stability.

NACA TN 3122

EXPERIMENTAL INVESTIGATION AT A MACH NUMBER OF 2.41 OF AVERAGE SKIN-FRICTION COEFFICIENTS AND VELOCITY PROFILES FOR LAMINAR AND TURBULENT BOUNDARY LAYERS AND AN ASSESSMENT OF PROBE EFFECTS. Robert M. O'Donnell. January 1954. 38p. diagrs., photos. (NACA TN 3122)

Average skin-friction coefficients for laminar and turbulent flows were measured on a hollow cylinder at a Mach number of 2.41 and over a Reynolds number range from 0.06×10^6 to 0.95×10^6 per inch. Comparisons with various laminar- and turbulent-boundary-layer theories are presented, together with an assessment of probe effects.

NACA TN 3124

A METHOD FOR ESTIMATING THE EFFECT OF TURBULENT VELOCITY FLUCTUATIONS IN THE BOUNDARY LAYER ON DIFFUSER TOTAL-PRESSURE-LOSS MEASUREMENTS. Jerome Persh and Bruce M. Bailey. January 1954. 16p. diagrs. (NACA TN 3124)

A method has been devised for estimating the effect of turbulent velocity fluctuations on diffuser total-pressure-loss measurements. In the development of this method, continuity of flow is stipulated, and it is assumed that the inlet conditions and the diffuser dimensions are accurately known, that the flow is symmetrical, and that the velocity outside the boundary layer at the downstream measuring stations is not measurably influenced by turbulent velocity fluctuations. Only the case of a conical diffuser with incompressible flow is considered, although the procedure may be easily modified to include compressible-flow considerations.

NACA TN 3131

ON THE KERNEL FUNCTION OF THE INTEGRAL EQUATION RELATING THE LIFT AND DOWNWASH DISTRIBUTIONS OF OSCILLATING FINITE WINGS IN SUBSONIC FLOW. Charles E. Watkins, Harry L. Runyan and Donald S. Woolston. January 1954. 44p. (NACA TN 3131)

The kernel function of an integral equation relating the downwash to the lift distribution of a finite wing oscillating in subsonic compressible flow is treated. The kernel is reduced to a form which is amenable to calculations and the types of singularities are shown. As a check, it is shown that the kernel for the three-dimensional case reduces exactly to the known kernel for the two-dimensional case. In addition, results for the special cases of Mach number of 0 (incompressible case) and frequency of 0 (steady case) are given.

NACA TN 3132

FATIGUE TESTS AT STRESSES PRODUCING FAILURE IN 2 TO 10,000 CYCLES. 24S-T3 AND 75S-T6 ALUMINUM-ALLOY SHEET SPECIMENS WITH A THEORETICAL STRESS-CONCENTRATION FACTOR OF 4.0 SUBJECTED TO COMPLETELY REVERSED AXIAL LOAD. Herbert F. Hardrath and Walter Illg. January 1954. 14p. diagrs., photo., 2 tabs. (NACA TN 3132)

Notched specimens made of 24S-T3 and 75S-T6 aluminum-alloy sheet material, with theoretical stress-concentration factors equal to 4.0, were subjected to completely reversed axial loads. Failures occurred in less than 50 cycles at two-thirds of the static tensile strength and in as few as 2 cycles when the applied load was near the static strength of the specimen. The S-N curves were found to be concave upward for almost the complete range of fatigue lives; a reversal of curvature occurred at about 10

cycles of load. The fatigue strengths were equivalent for specimens made of each of the two materials and tested at stresses below 25 ksi; above that stress the 75S-T6 specimens had the greater fatigue strength. Compared on the basis of percent of ultimate tensile strength, the 24S-T3 specimens were stronger at all stress levels. Test techniques and special test apparatus are described.

NACA TN 3133

THE FREE-STREAM BOUNDARIES OF TURBULENT FLOWS. Stanley Corrsin and Alan L. Kistler, Johns Hopkins University. January 1954. 109p. diagrs., photos. (NACA TN 3133)

An experimental and theoretical study has been made of the instantaneously sharp and irregular front which separates turbulent fluid from contiguous "nonturbulent" fluid at a free-stream boundary. The overall behavior of the front is described statistically in terms of its wrinkle-amplitude growth and its lateral propagation relative to the fluid as functions of downstream coordinate. It is proposed and justified that the front actually consists of a very thin fluid layer in which direct viscous forces transmit mean and fluctuating vorticity to previously nonturbulent fluid. Outside this "laminar superlayer" there is presumably a field of irrotational velocity fluctuations (the "nonturbulent" flow) with constant mean velocity. Theoretical analysis based on this physical picture gives results which are in plausible agreement with experimental results for three turbulent shear flows.

NACA TN 3136

CREEP BENDING AND BUCKLING OF LINEARLY VISCOELASTIC COLUMNS. Joseph Kempner, Polytechnic Institute of Brooklyn. January 1954. 22p. diagrs. (NACA TN 3136)

The general dynamic equation of creep bending of a beam loaded laterally and axially was derived for a linearly viscoelastic material whose mechanical properties can be characterized by four parameters. The material can exhibit instantaneous and retarded elasticity as well as pure flow. The equation was used to determine creep characteristics of a beam in pure bending and a column with an initially sinusoidally deformed axis. The results showed that creep deflection characteristics of the beam are identical to the creep strain characteristics of a bar under simple tension or compression. For compressive end loads less than the Euler load, the column exhibited creep deflections which increase continuously with time and approach infinity only as time approaches infinity.

NACA TN 3137

CREEP BENDING AND BUCKLING OF NONLINEARLY VISCOELASTIC COLUMNS. Joseph Kempner, Polytechnic Institute of Brooklyn. January 1954. 27p. diagrs., 3 tabs. (NACA TN 3137)

Differential equations of bending of an idealized H-section beam column were derived for a nonlinearly viscoelastic material whose mechanical properties are analogous to a model consisting of a linear spring in series with a nonlinear dashpot whose strain rate is proportional to a power of the applied stress. The equations were used to obtain the creep-bending deflections of a beam in pure bending and of a column with initial sinusoidal deviation from straightness. The results for the simple beam showed that the deflections vary linearly with time. The results for the column, with the assumption that the original shape was maintained, showed the existence of a finite critical time at which the deflections become indefinitely large. The critical time decreases rapidly with increasing axial compression and column inaccuracy.

NACA TN 3138

CREEP BUCKLING OF COLUMNS. Joseph Kempner and Sharad A. Patel, Polytechnic Institute of Brooklyn. January 1954. 24p. diagrs., 2 tabs. (NACA TN 3138)

Formulas are presented for the determination of the creep deflection-time characteristics of an initially curved idealized H-section column. These results were obtained from closed-form solutions of the differential equation of bending (derived in NACA TN 3137) of a beam column whose creep properties are of a nonlinearly viscoelastic nature. The critical time (the time required for infinite deflections to develop) established by these solutions is tabulated and plotted for a wide range of the parameters involved.

NACA TN 3139

TIME-DEPENDENT BUCKLING OF A UNIFORMLY HEATED COLUMN. Nathan Ness, Polytechnic Institute of Brooklyn. January 1954. 18p. diagrs. (NACA TN 3139)

A theoretical investigation is presented of the time-temperature- dependent buckling of a pin-jointed constant-section column, whose initial curvature is defined by a half-sine wave when the material is linearly viscoelastic and is heated uniformly along the column at a prescribed time rate. It was found that the deviations from straightness increase with time and become indefinitely large when heating reduces the Young's modulus of the material to the value at which the applied load is the Euler load of the column. When the column is heated very rapidly this critical time represents its limit of usefulness. When heating takes place less rapidly the deflections cause bending stresses exceeding the yield stress of the material at a time considerably smaller than the critical time.

NACA TN 3157

METHOD FOR CALCULATION OF COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH AXIAL PRESSURE GRADIENT AND HEAT TRANSFER. Paul A. Libby and Morris Morduchow, Polytechnic Institute of Brooklyn. January 1954. 44p. diagrs. (NACA TN 3157)

A rapid and sufficiently accurate method, for most practical purposes, of determining laminar-boundary-layer characteristics in flow with a given free-stream Mach number and given velocity distribution at the edge of the boundary layer is presented. The method can be easily applied to flow with zero pressure gradient for any (constant) Prandtl number of the order of unity and any given temperature distribution along the wall. For flow in an axial pressure gradient, the method can be applied for a Prandtl number of unity and any given uniform wall temperature.

NACA RM E53J07

MEASUREMENT OF HEAT-TRANSFER AND FRICTION COEFFICIENTS FOR FLOW OF AIR IN NONCIRCULAR DUCTS AT HIGH SURFACE TEMPERATURES. Warren H. Lowdermilk, Walter F. Weiland, Jr. and John N. B. Livingood. January 1954. 26p. diagrs. (NACA RM E53J07)

Measurements of average heat-transfer and friction coefficients were obtained with air flowing through electrically heated ducts having square, rectangular (aspect ratio, 5), and triangular cross sections for a range of surface temperature from 540° to 1780° R and Reynolds number from 1000 to 330,000. The results indicate that the effect of heat flux on correlations of the average heat-transfer and friction coefficients is similar to that obtained for circular tubes in a previous investigation and was nearly eliminated by evaluating the physical properties and density of the air at a film temperature halfway between the average surface and fluid bulk temperatures. With the Nusselt and Reynolds numbers based on the hydraulic diameter of the ducts, the data for the noncircular ducts could be represented by the same equations obtained in the previous investigation for circular tubes. Correlation of the average difference between the surface corner and midwall temperatures for the square duct was in agreement with predicted values from a previous analysis. However, for the rectangular and triangular ducts, the measured corner temperature was greater by approximately 20 and 35 percent, respectively, than the values predicted by analysis.

NACA TM 1364

THE PLANE PROBLEM OF THE FLAPPING WING. (Das ebene problem des schlagenden flugels). Walter Birnbaum. January 1954. 38p. diagrs., tab. (NACA TM 1364. Trans. from Zeitschrift für augewandte Mathematik und Mechanik, v.4, no.4, August 1924, p.277-292).

A theoretical study, based on vortex theory as applied to the linearized equattons of motion, is made of the atr forces on wings of infinite aspect ratio in incompressible flow. Expressions for forces and moments associated with steady harmonic oscillations in vertical translation and pitching of wings are derived in the form of power series in terms of a reduced frequency parameter. Use is made of the derived forces first to treat the problem of propulsion due to wing flapping and second to determine theoretical flutter speeds of some simple spring mounted configurations.

BRITISH REPORTS

N-28052*

Royal Aircraft Establishment (Gt. Brit.)
SOME NOTES ON THE DESIGN AND PERFORMANCE OF A THERMAL WATER CONTENT METER FOR USE IN CLOUDS. J. Rudman and F. J. Bigg. September 1953. 33p. diagrs., photos. (RAE Tech. Note Mech. Eng. 145)

Various methods of measuring the liquld water content of clouds are briefly reviewed and their probable applications pointed out. It is concluded that the best type of indicator for use primarily as a warning instrument in conditions of icing is one of a thermal type. An instrument is described which consists of two small heated cylinders, one exposed and the other in a sheltered position. Free water caught on the exposed cylinder produces a temperature difference, relative to the sheltered one, which is used as a measure of free water content. A theoretical analysis of the performance of this type of instrument shows that it is likely to be satisfactory as a warning device but only good for accurate measurement over a limited range of water concentrations, unless a resetting process is used.

N-28053*

Royal Aircraft Establishment (Gt. Brit.)
THE ABSORPTIOMETRIC DETERMINATION OF MAGNESIUM IN TITANIUM METAL. A. Bacon. September 1953. 27p. diagrs., 11 tabs. (RAE Tech. Note Met. 177)

Magnesium is separated in alkaline solutions, using hydrogen peroxide to prevent precipitation of the titanium. The magnesia is redissolved in standard acid and determined on the "Spekker" using Eriochrome Cyanine as the color reagent. Magnesium values are given for several samples of "Kroll" titanium.

N-28054*

Royal Aircraft Establishment (Gt. Brit.)
CORROSION, STRESS-CORROSION AND FATIGUE TESTS ON AN ALUMINIUM ALLOY HAVING A HIGH YOUNG'S MODULUS. G. Meikle, C. Braithwaite and M. S. Binning. September 1953. 7p. diagr., 2 tabs. (RAE Tech. Note Met. 180)

Corrosion tests have been made on an aluminum alloy containing 10.5 percent silicon and other elements to produce a high "E" value. The corrosion resistance of the alloy was not good, having lost about 17 percent of the proof stress and about 30 percent of the U. T. S. in 12 months' exposure to sea water spray. The stress corrosion resistance of the alloy was not very good. High fatigue results showed that improvement was imparted to the solution treated material but not to be fully heat-treated alloy by polishing. Reverse bend fatigue tests also showed an improvement by polishing the solution treated alloy but no improvement by polishing the fully heat-treated material.

N-28055*

Royal Aircraft Establishment (Gt. Brit.)
THE EFFECT OF HEATING SOME ALUMINIUM ALLOYS FOR SHORT PERIODS UP TO 340°C. September 1953. 10p. diagrs., 3 tabs. (RAE Tech. Note Met. 181)

Samples of 20 S.W.G. (0.036 in.) sheets of DTD.610, DTD.546, and DTD.687 were heated at 200°, 250°, 300°, and 340° C for periods from 5 seconds to 32 minutes. The loss in strength of DTD.610 and DTD.546 at 200° C is negligible but becomes appreciable as the temperature is increased. DTD.687 loses strength at 200° C even with very short periods of heating. When heated at 340° C, resolution occurs in DTD.687 which, on subsequent natural ageing, offsets the loss of strength due to softening at 340° C.

N-28057*

Aeroplane and Armament Experimental Establishment (Gt. Brit.) THE PERFORMANCE OF A MULTI-ENGINE HELICOPTER FOLLOWING FAILURE OF ONE ENGINE DURING TAKE-OFF OR LANDING. A. L. Oliver. October 30, 1953. 15p. diagrs., tab. (AAEE/Res/277)

A theoretical analysis is made of the performance of multiengine helicopters following failure of one engine in take-off and landing from the type of site proposed for civil operation in built-up areas. The performance of a twin engine helicopter of similar class to the Bristol 173 appears to be just adequate for safe operation from such a site but the nicety of handling judgment involved in return landings may make the performance difficult to achieve. A take-off technique allowing climb-away after engine failure at any stage is preferable but this is not possible for the twin engine machine within the space available. It is possible if the twin engines are replaced by four of the same effective total power but only if a turning climb-away is made after engine failure. A helicopter with sufficient performance for a straight climb-away can in general hover with one engine inoperative.

N-28058*

Royal Aircraft Establishment (Gt. Brit.)
A METHOD OF APPROXIMATE NUMERICAL SOLUTION OF NON-LINEAR DIFFERENTIAL EQUATIONS OF THE FORM, $\ddot{x} + f_1(\dot{x}, x) + f_2(x) = 0$.
G. S. Green and H. G. Cuming. September 1953. 16p. diagrs., tab. (RAE Tech. Note GW 277)

A method is suggested for deriving numerically the essential characteristics of the oscillatory motion whose nonlinear differential equation is of the form $\ddot{x} + f_1(\dot{x}, x) + f_2(x) = 0$. An example of the application of the method to a particular case is given.

N-28099*

Aeronautical Research Council (Gt. Brit.)
ACTUATOR DISC APPLIED TO WALL BOUNDARY LAYERS IN CASCADES. W. R. Hawthorne and J. H. Horlock. December 22, 1952. 32p. diagrs. (ARC 15,490; EA 270)

Using the actuator disk theory developed by Bragg and Hawthorne and Pinsley, a solution for the flow of a perfect fluid with initial velocity gradients through a moving cascade is found. The boundary-layer form factor at exit from the cascade is shown to be dependent upon the entry boundary-layer parameters, the exit air angle relative to the cascade, and the ratio of cascade blade speed to the main stream axial velocity at entry. A comparison is made between the values of these variables at which the cascade would stall, and those at which the flow might be expected to break away from the wall. The investigation is extended to consider a complete compressor stage.

N-28100*

Aeronautical Research Council (Gt. Brit.)
SOME ACTUATOR DISC THEORIES FOR THE FLOW OF AIR THROUGH AN AXIAL TURBO MACHINE. J. H. Horlock. December 22, 1952. 47p. diagrs., tab. (ARC 15,491; EA 271)

Using actuator disk theory, simplified methods are given for the solution of the direct problem of the incompressible flow of air through an axial flow turbomachine. Calculations based on these methods are compared with other approximate solutions to the flow through a model compressor stage.

N-28106*

Aeronautical Research Council (Gt. Brit.)
ON THE SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR A TYPE OF STEADY RADIALLY-SYMMETRIC VISCOUS FLOW. S. C. R. Dennis. March 11, 1953. 13p. diagrs. (ARC 15,723; FM 1878)

The solution of the Navier-Stokes equations for the steady motion of a viscous fluid near an infinite rotating disk can be made to depend upon the solution of a pair of simultaneous nonlinear ordinary differential equations; the same equations govern the flow between two coaxial rotating disks. In this paper a method of solution is developed sufficiently to give some numerical results in a number of related cases. The results given are not necessarily unique, for in some cases the equations have been found to admit of more than one solution. Further solutions are not considered here, but it is hoped in a later paper to describe a method of obtaining them.

MISCELLANEOUS

NACA TN 1983

Errata No. 1 on "LONGITUDINAL FLYING QUALITIES OF SEVERAL SINGLE-ROTOR HELICOPTERS IN FORWARD FLIGHT." F. B. Gustafson, Kenneth B. Amer, C. R. Haig and J. P. Reeder. November 1949.

NACA TN 2590

Errata No. 2 on "CALCULATIONS ON THE FORCES AND MOMENTS FOR AN OSCILLATING WING-AILERON COMBINATION IN TWO-DIMENSIONAL POTENTIAL FLOW AT SONIC SPEED." Herbert C. Nelson and Julian H. Berman. January 1952.

UNPUBLISHED PAPERS

N-15407*

National Bureau of Standards.
THERMODYNAMIC PROPERTIES OF GASEOUS DIFLUORODICHLOROMETHANE (FREON-12). Joseph F. Masi. March 20, 1952. i, 19p. diagrs., tabs. (National Bureau of Standards. Rept. 1532)

Heat capacities of gaseous difluorodichloromethane (Freon-12) were measured with the flow calorimeter from the boiling point of CF_2Cl_2 up to 90° C and at pressures up to 1.5 atmospheres. Tables of the heat capacity, enthalpy, entropy, and free energy function of the ideal gas have been calculated for temperatures from 200° to 1500° Kelvin.

N-27652*

National Bureau of Standards.
THE REPRESENTATION OF GAS PROPERTIES IN TERMS OF MOLECULAR CLUSTERS. Harold W. Woolley. March 1, 1952. ii, 13p. diagrs., tabs. (National Bureau of Standards. Rept. 1491)

This report presents a new and more adequate method for representing the actual thermodynamic properties of nonpolar gases, through the modification of the usual selection of force law parameters for the Lennard-Jones type of interaction potential. Instructions and generalized tables and charts are included which, together with existing tables of second and third virial coefficients, facilitate the fitting of experimental data for all nonpolar gases. Results are shown for A, N_2, CO, CO_2, CH_4, C_2H_4.

DECLASSIFIED NACA REPORTS

THE RECLASSIFICATION CHANGES LISTED IN THIS ISSUE COMPLETE THE ACTION REQUIRED BY EXECUTIVE ORDER NO. 10501 ON REPORTS INITIALLY ISSUED BY THE NACA AS RESTRICTED.

THE FOLLOWING REPORTS HAVE BEEN DECLASSIFIED FROM RESTRICTED TO UNCLASSIFIED, 12/14/53.

NACA RM 8C29

A RESTRICTED LIST OF AIRCRAFT MATERIALS RESEARCH PROJECTS. Sponsored by Government Agencies. May 4, 1948. 95p. (NACA RM 8C29)

This report contains a selected list of Government sponsored research projects on related aircraft materials in effect during the calendar year 1947. Information is contained on titles, description, sponsoring and conducting agencies.

NACA RM A7D10

THE DEVELOPMENT OF JET-ENGINE NACELLES FOR A HIGH-SPEED BOMBER DESIGN. Robert E. Dannenberg. August 29, 1947. 37p. diagrs., photos., tab. (NACA RM A7D10)

The results of an experimental investigation made for the purpose of developing suitable jet-engine nacelle designs for a high-speed medium bomber are presented. Two types of nacelles were investigated, the first enclosing two 4000-pound-thrust jet engines and a 65-inch-diameter landing wheel and the second enclosing a single 4000-pound-thrust jet engine. Both types of nacelles were tested in positions underslung beneath the wing and centrally located on the wing. The report summarizes the low-speed investigation and includes some results from the high-speed portion.

NACA RM A7I06

AN EXPERIMENTAL INVESTIGATION OF NACA SUBMERGED AIR INLETS ON A 1/5-SCALE MODEL OF A FIGHTER AIRPLANE. Donald E. Gault. December 5, 1947. 32p. diagrs., photos., 4 tabs. (NACA RM A7I06)

The results of an experimental investigation of an NACA submerged inlet system on a 1/5-scale model of a fighter airplane are presented. Duct system total pressure losses and pressure distributions over the lip and ramp were obtained. It is shown that the inlet location investigated is unsatisfactory.

NACA RM A7I26

PRELIMINARY RESULTS OF A FLIGHT INVESTIGATION TO DETERMINE THE EFFECT OF NEGATIVE FLAP DEFLECTION ON HIGH-SPEED LONGITUDINAL-CONTROL CHARACTERISTICS. Maurice D. White, Melvin Sadoff, Lawrence A. Clousing and George E. Cooper. December 16, 1947. 22p. diagrs., photos. (NACA RM A7I26)

Flight tests were conducted on two airplanes having wings of different airfoil section to determine the effect of deflecting the landing flaps upward on the high-speed longitudinal-control characteristics. For the airplane with the NACA 66-series airfoil, a decrease in the diving tendency at high Mach numbers resulted from a reduction in the variation of wing and tail angle of attack with Mach number with deflected flaps. For the airplane with the NACA 230-series airfoil, a change in the pitching moment of the airplane without the tail apparently offset the effect produced by the reduction of the angle-of-attack variation so that no appreciable improvement in diving tendencies resulted with deflected flaps.

NACA RM A7I30

AN EXPERIMENTAL INVESTIGATION OF THE DESIGN VARIABLES FOR NACA SUBMERGED DUCT ENTRANCES. Emmet A. Mossman and Lauros M. Randall. January 8, 1948. 59p. diagrs., 3 tabs. (NACA RM A7I30)

The effect of configuration modifications on the characteristics of NACA submerged duct entrances is presented. These tests were made with the duct inlet installed in the wall of an 8-inch by 36-inch wind channel. The modifications investigated were ramp plan form, ramp angle, width-to-depth ratio, ramp floor shape, deflectors and boundary-layer thickness.

NACA RM A7J13

AN ANALYSIS OF THE EFFECTS OF WING ASPECT RATIO AND TAIL LOCATION ON STATIC LONGITUDINAL STABILITY BELOW THE MACH NUMBER OF LIFT DIVERGENCE. John S. Axelson and J. Conrad Crown. January 9, 1948. 14p. diagrs. (NACA RM A7J13)

An analysis of the influence of wing aspect ratio and tail location on the effects of compressibility on static longitudinal stability indicates that the use of reduced wing aspect ratios or short tail lengths lead to serious reduction in high-speed stability below the Mach number of lift divergence.

NACA RM A7J22

HIGH-SPEED AERODYNAMIC CHARACTERISTICS OF A MODEL TAIL PLANE WITH MODIFIED NACA 65-010 SECTIONS AND 0° AND 45° SWEEPBACK. Joseph L. Anderson and Andrew Martin. January 12, 1948. 85p. diagrs., photo., 2 tabs. (NACA RM A7J22)

This report presents high-speed aerodynamic characteristics determined from wind-tunnel tests of a model tail plane having modified NACA 65-010 sections and a tapered plan form. Results are shown for the tail plane in an unswept and a 45° sweptback condition. For the unswept tail the Mach number of lift divergence was 0.80 while for the sweptback tail it was above 0.875. The report shows how the substitution of a 45° sweptback horizontal tail for an unswept tail affects the longitudinal stability and control forces of an airplane.

NACA RM A7J23

HIGH-SPEED AERODYNAMIC CHARACTERISTICS OF FOUR THIN NACA 63-SERIES AIRFOILS. Richard J. Ilk. December 31, 1947. 53p. diagrs., photo., tab. (NACA RM A7J23. Now issued as TN 2670)

This report contains the results of high-speed wind-tunnel tests made of the NACA 63-206, 63-208, 63-210, and 63-212 airfoil sections. The results indicate the effect of thickness on the aerodynamic characteristics of thin NACA 63-series airfoils. The data of these tests have been compared to similar data for corresponding NACA 64-series airfoils to show the effect of thickness distribution on the high-speed aerodynamic characteristics of NACA 6-series airfoils. It was concluded that, although the differences are small, the aerodynamic characteristics of thin NACA 64-series airfoils are more favorable for high-speed applications than those of comparable NACA 63-series airfoils.

NACA RM A7L02

A SUMMARY AND ANALYSIS OF WIND-TUNNEL DATA ON THE LIFT AND HINGE-MOMENT CHARACTERISTICS OF CONTROL SURFACES UP TO A MACH NUMBER OF 0.90. John A. Axelson. April 30, 1948. 43p. diagrs., tab. (NACA RM A7L02)

This report contains an extensive summary of wind-tunnel data showing the lift and hinge-moment characteristics of control surfaces up to a Mach number of 0.90. The many factors affecting C_{h_α}, C_{h_δ}, C_{L_α}, and C_{L_δ} are discussed, including sweep, airfoil section, aerodynamic balance, control surface profile, and trailing-edge angle.

NACA RM A8H12

HIGH-SPEED AERODYNAMIC CHARACTERISTICS OF A LATERAL-CONTROL MODEL. I - NACA 0012-64 SECTION WITH 20-PERCENT-CHORD PLAIN AILERON AND 0° AND 45° SWEEPBACK. Joseph L. Anderson and Walter J. Krumm. September 27, 1948. 28p. diagrs., photo., 2 tabs. (NACA RM A8H12)

Wind-tunnel tests were made to determine the aerodynamic and lateral-control characteristics of a semispan wing having the NACA 0012-64 section. The characteristics were determined through a large Mach number range for the wing unswept and swept back 45° and for a 20-percent-chord, plain, trailing-edge aileron. Results indicate an aileron overbalance and effectiveness reversal at high subsonic Mach numbers for the wing unswept but only an overbalance for the wing swept back 45°.

NACA RM A9G19

COMPARISON OF THE AERODYNAMIC CHARACTERISTICS OF THE NACA 0010 AND 0010-64 AIRFOIL SECTIONS AT HIGH SUBSONIC MACH NUMBERS. Perry P. Polentz. October 7, 1949. 23p. diagrs., tab. (NACA RM A9G19)

Section lift, drag, and pitching-moment characteristics of the NACA 0010 and NACA 0010-64 airfoil sections measured at Mach numbers up to 0.91 and Reynolds numbers between 1.0×10^6 and 1.9×10^6 are presented. Comparisons are made to determine the principal effects of varying the chordwise location of the maximum thickness.

NACA RM A9K22

EXPLORATORY INVESTIGATION OF THE EFFECT OF SKEWED PLAIN NOSE FLAPS ON THE LOW-SPEED CHARACTERISTICS OF A LARGE-SCALE TRIANGULAR-WING-FUSELAGE MODEL. Bradford H. Wick and David Graham. January 12, 1950. 12p. diagrs., photo. (NACA RM A9K22)

Presented are lift, drag, and pitching-moment data obtained from tests of a triangular-wing-fuselage combination with skewed nose flaps. The Reynolds numbers of the tests were 12.5 and 14.1 million (based on the wing mean aerodynamic chord). The semi plan form of the flaps was such that the flap chord varied from 0 percent wing chord at the model center line to 100 percent at about 91-percent wing semispan. It was concluded that skewed nose flaps of the investigated plan form are a promising means of delaying both the leading-edge separation and the tip stalling that occur on a thin, low-aspect-ratio triangular wing.

NACA RM A9L27

HIGH-SPEED AERODYNAMIC CHARACTERISTICS OF A LATERAL-CONTROL MODEL. II - MODIFIED NACA 0012-64 SECTION WITH A 26.6-PERCENT-CHORD, PLAIN, TRAILING-EDGE AILERON; WING UNSWEPT AND SWEPT BACK 45°. Walter J. Krumm and Joseph L. Anderson. March 15, 1950. 55p. diagrs., photo., 2 tabs. (NACA RM A9L27)

Wind-tunnel tests were made to determine the aerodynamic characteristics of a semispan model wing having a modified NACA 0012-64 section. The lateral-control characteristics for a 26.6-percent-chord, plain, trailing-edge aileron were determined for a Mach number range from 0.40 through 0.925 with the wing unswept and swept back 45°.

NACA RM E6I20

ALTITUDE-WIND-TUNNEL INVESTIGATIONS OF THRUST AUGMENTATION OF A TURBOJET ENGINE. I - PERFORMANCE WITH TAIL-PIPE BURNING. W. A. Fleming and R. O. Dietz. September 25, 1946. 56p. diagrs., photos. (NACA RM E6I20)

Engine thrust and fuel consumption were determined for a wide range of simulated flight conditions and tail-pipe fuel flows. The investigation was particularly directed toward evaluation of thrust augmentation for high-speed and high-altitude flight. The engine tail pipe was modified for the investigation to reduce the gas velocity at the inlet of the tail-pipe combustion chamber. The general trends of the experimental values were in agreement with values calculated from theoretical equations.

NACA RM E6K27

INVESTIGATION OF SHOCK DIFFUSERS AT MACH NUMBER 1.85. I - PROJECTING SINGLE-SHOCK CONES. W. E. Moeckel, J. F. Connors and A. H. Schroeder. June 17, 1947. 47p. diagrs., photos. (NACA RM E6K27)

Single-shock cones having angles of 20°, 30°, 40°, 50°, 60°, and 70° were tested with curved and straight diffuser-inlet sections. The variation of total-pressure recovery with tip projection and outlet area was investigated for each cone to determine optimum contraction ratios and shock locations. The effect of angle of attack was also investigated for several configurations. Maximum total-pressure recovery was obtained with the 50° cone using the straight inlet. The highest total-pressure recoveries were obtained with subsonic entrance flow.

NACA RM E6L13

INVESTIGATION OF SHOCK DIFFUSERS AT MACH NUMBER 1.85. II - PROJECTING DOUBLE-SHOCK CONES. W. E. Moeckel, J. F. Connors and A. H. Schroeder. June 17, 1947. 41p. diagrs., photos. (NACA RM E6L13)

The total-pressure recovery (at a Mach number of 1.85) of a shock diffuser having projecting cones designed to produce two oblique shocks ahead of the diffuser inlet was investigated. Four cones with different included angles were used. Each cone was investigated with a straight and with a curved diffuser-inlet section. The effect of angle of attack and the distribution of static and total pressures at the diffuser outlet were also investigated for the best configurations. The highest total-pressure recoveries were obtained with subsonic inlet flow. The results were compared with those obtained with single-shock cones.

NACA RM E6L27a

CHARACTERISTICS OF A HOT JET DISCHARGED FROM A JET-PROPULSION ENGINE. William A. Fleming. December 27, 1946. 20p. diagrs. (NACA RM E6L27a)

An investigation of a heated jet was conducted to provide information by which an engine could be so located in an airplane that no external surface is overheated by the jet. The temperature and the velocity on the axis of the jet and the diameter of the jet are presented nondimensionally as functions of the axial distance from the jet-nozzle outlet and the diameter of the jet at the vena contracta.

NACA RM E7B11h

COMPUTED TEMPERATURE DISTRIBUTION AND COOLING OF SOLID GAS-TURBINE BLADES. J. George Reuter and Carl Gazley, Jr. February 11, 1947. 13p. diagrs., tab. (NACA RM E7B11h)

Computations were made to determine the effects of gas temperature, blade-root temperature, blade thermal conductivity, and net gas-to-metal heat-transfer coefficient on the temperature distribution in a typical solid turbine blade.

NACA RM E7C12

ALTITUDE-WIND-TUNNEL INVESTIGATION OF THRUST AUGMENTATION OF A TURBOJET ENGINE. II - PERFORMANCE WITH WATER INJECTION AT COMPRESSOR INLET. Robert O. Dietz and William A. Fleming. May 19, 1947. 33p. diagrs. (NACA RM E7C12)

Engine performance at an engine speed of 7600 rpm was obtained over a wide range of water-air ratios at pressure altitudes of 5,000 and 20,000 feet and at a ram-pressure ratio corresponding to a flight Mach number of about 0.265. A fixed-area tail-pipe nozzle 16-3/8 inches in diameter was used for this investigation. Data are presented to show the effect of water injection on engine performance. A discussion of the effect of water injection on the pressure and temperature distribution at the compressor outlet of the turbojet engine is included.

NACA RM E7C26

THE USE OF PERFORATED INLETS FOR EFFICIENT SUPERSONIC DIFFUSION. John C. Evvard and John W. Blakey. June 25, 1947. 34p. diagrs., photo. (NACA RM E7C26. Now issued as RM E51B10)

The use of wall perforations on supersonic diffusers to avoid the internal contraction-ratio limitation is described. Experimental results at a Mach number of 1.85 on a preliminary model of a perforated diffuser having a geometric internal contraction ratio of 1.49 (the isentropic value) are presented. A theoretical discussion of the flow coefficients as well as the size and the spacing of the perforations is also included. At angles of attack of 0°, 3°, and 5°, total-pressure recoveries of 0.931, 0.920, and 0.906, respectively, were obtained.

NACA RM E7D22

A FUEL-DISTRIBUTION CONTROL FOR CONTINUOUS-FLOW MANIFOLD INJECTION ON RECIPROCATING ENGINES. Harold Gold and David M. Straight. June 6, 1947. 16p. diagrs., photos. (NACA RM E7D22)

A fuel-distribution control for continuous-flow manifold injection on reciprocating engines is described. A method of installation of the control on an engine is suggested.

NACA RM E7E12

PRELIMINARY INVESTIGATION OF EFFECTS OF GAMMA RADIATION ON AGE-HARDENING RATE OF AN ALUMINUM-COPPER ALLOY. J. Howard Kittel. June 20, 1947. 4p. diagr. (NACA RM E7E12)

A preliminary investigation was made to determine the effects of gamma radiation on the age-hardening rate of an aluminum-copper alloy at temperatures of 32° and 70° F. The gamma radiation from a 100-milligram radium source appeared to have no significant effect on the age-hardening rate of the alloy. A metallographic examination of the test specimens showed no microstructural changes that could be attributed to the gamma radiation.

NACA RM E7E13

PRELIMINARY INVESTIGATION OF EFFECTS OF ALPHA-PARTICLE BOMBARDMENT ON THE CREEP RATE OF ALUMINUM. J. Howard Kittel. July 3, 1947. 6p. diagrs. (NACA RM E7E13)

A preliminary investigation was made to determine the effects of alpha-particle bombardment on the creep rate of aluminum wire at 400° F. The alpha radiation from an 85-millicurie polonium source appeared to decrease slightly the creep rate of the aluminum. A metallographic examination of the creep specimens showed no microstructural changes that could be attributed to the alpha-particle bombardment.

NACA RM E7F10

ALTITUDE-WIND-TUNNEL INVESTIGATION OF THRUST AUGMENTATION OF A TURBOJET ENGINE. III - PERFORMANCE WITH TAIL-PIPE BURNING IN STANDARD-SIZE TAIL PIPE. William A. Fleming and Richard L. Golladay. August 11, 1947. 47p. diagrs., photos. (NACA RM E7F10)

Thrust augmentation of a turbojet engine by burning fuel in the tail pipe has been investigated in the NACA Cleveland altitude wind tunnel. The engine performance was determined at several simulated flight conditions throughout the range of tail-pipe fuel flows. A tail-pipe combustion chamber having the same external dimensions as the standard turbojet engine tail pipe was investigated to determine whether satisfactory operation could be obtained at high-speed and high-altitude flight conditions. Two different flame holders were used.

NACA RM E7F11

COMBUSTION-EFFICIENCY INVESTIGATION OF SPECIAL FUELS IN SINGLE TUBULAR-TYPE COMBUSTOR AT SIMULATED ALTITUDE CONDITIONS. Ralph T. Dittrich. August 15, 1947. 25p. diagrs., 2 tabs. (NACA RM E7F11)

Ten special straight-run distillate fuels were investigated. The distillates were obtained from various crude oils and consisted of hydrocarbon mixtures with distillation temperatures varying from 93° to 690° F. Three commercial fuels were also tested. The operating conditions simulated engine operation at an altitude of 40,000 feet at engine speeds of 7000 and 10,500 rpm. Under certain operating conditions the flame extended beyond the turbine position. The tests showed that as the distillation temperature of the fractions from the same crude increased, the combustion efficiency decreased.

NACA RM E7F12

FUEL INVESTIGATION IN A TUBULAR-TYPE COMBUSTOR OF A TURBOJET ENGINE AT SIMULATED ALTITUDE CONDITIONS. Adelbert O. Tischler and Ralph T. Dittrich. August 1, 1947. 41p. diagrs., photo., 2 tabs. (NACA RM E7F12)

A series of 11 fuels, which ranged in volatility from gasoline to Diesel oil and which included hydrocarbons of the paraffinic, naphthenic, olefinic, and aromatic types, was tested in a single tubular combustion chamber of a turbojet engine under inlet-air conditions that simulated engine operation at two engine speeds at an altitude of 40,000 feet. Tests were also conducted at two additional inlet-air conditions. Temperature-rise data at various fuel-air ratios were obtained for each set of air-flow conditions.

NACA RM E7G03

EXPERIMENTAL INVESTIGATION OF PERFORMANCE AND OPERATING CHARACTERISTICS OF A TAIL-PIPE BURNER FOR A TURBOJET ENGINE. David S. Gabriel, E. Vincent Martinson and Robert H. Essig. October 30, 1947. 29p. diagrs. (NACA RM E7G03)

Presents description and operating characteristics of 10 full-scale tail-pipe burners. The combustion and pressure-drop characteristics of most satisfactory burner were investigated. A tail-pipe burner was developed that operated satisfactorily over a range of fuel-air ratios with inlet conditions of gas temperature and velocity simulating those in a typical turbojet engine.

NACA RM E7I25a

AN ANALYSIS OF CONTROL REQUIREMENTS AND CONTROL PARAMETERS FOR DIRECT-COUPLED TURBOJET ENGINES. David Novik and Edward W. Otto. February 18, 1948. 50p. diagrs. (NACA RM E7I25a)

Presents discussion of control parameters for direct-coupled turbojet engine, based on analysis of steady-state operation, acceleration, and deceleration, and describes operation of a hypothetical control system.

NACA RM E7J19

EXPERIMENTAL INVESTIGATION OF THRUST AUGMENTATION OF 4000-POUND-THRUST CENTRIFUGAL-FLOW-TYPE TURBOJET ENGINE BY INJECTION OF WATER AND ALCOHOL AT COMPRESSOR INLETS. William L. Jones and Helmuth W. Engelman. May 14, 1948. 23p. diagrs. (NACA RM E7J19)

Contains curves and data to determine amount of thrust augmentation obtainable by injection of various water and alcohol mixtures at compressor inlets of a 4000-pound-thrust turbojet engine at standard NACA conditions. A maximum thrust augmentation of 26 percent was obtained by injection of 4.5 pounds per second of water and 2.0 pounds per second of alcohol.

NACA RM E7K14

EXPERIMENTAL INVESTIGATION OF THRUST AUGMENTATION OF AXIAL-FLOW-TYPE 4000-POUND-THRUST TURBOJET ENGINE BY WATER AND ALCOHOL INJECTION AT COMPRESSOR INLET. Burnett Baron, Harry W. Dowman and William C. Dackis. July 8, 1948. 41p. diagrs., photos. (NACA RM E7K14)

Reports on experimental investigation of thrust augmentation of axial-flow-type turbojet engine with a 4000-pound-thrust rating by means of water-alcohol injection at the compressor inlet. Augmentation was limited by centrifugal separation of liquid and air in the compressor and was sensitive to engine inlet-air temperature. A thrust augmentation of 15.4 percent was obtained with injection of 3 pounds per second of water alone at an inlet-air temperature of 548° F.

NACA RM E7L12

RELATION OF NOZZLE-BLADE AND TURBINE-BUCKET TEMPERATURES TO GAS TEMPERATURES IN A TURBOJET ENGINE. J. Elmo Farmer. April 30, 1948. 37p. diagrs., photos. (NACA RM E7L12)

Presents results of investigation to determine experimentally turbine-nozzle-blade and turbine-bucket temperatures in a turbojet engine and to correlate these temperatures with gas temperatures. Maximum indicated temperatures were about 1900° F for the nozzle blade and 1500° F for the turbine bucket. The maximum turbine-nozzle-blade temperature was 80° to 270° F higher than the calculated average turbine-inlet-gas temperature; the maximum turbine-bucket temperature was about 150° F less than the calculated average turbine-inlet-gas temperature.

NACA RM E7L16

ALTITUDE-WIND-TUNNEL INVESTIGATION OF THRUST AUGMENTATION OF A TURBOJET ENGINE. IV - PERFORMANCE WITH TAIL-PIPE BURNING AND WATER INJECTION. Robert O. Dietz, Jr., George Wishnek and John K. Kuenzig. June 15, 1948. 31p. diagrs., photo. (NACA RM E7L16)

Results of investigation of thrust augmentation of axial-flow-type turbojet engine by combination of tail-pipe burning and water injection are presented. Thrust increases obtainable with engine-inlet water injection reached a peak at a water-air ratio of 0.035 and decreased with larger amounts of injection; whereas thrust increases obtainable with combustion-chamber water injection increased as water-air ratio was raised throughout range of water-air ratios investigated. Greater maximum thrust increases were available with combustion-chamber water injection than with engine-inlet water injection. Thrust increases were accompanied by large increases in specific liquid consumption.

NACA RM E7L17

CONTROL DURING STARTING OF GAS-TURBINE ENGINES. Robert J. Koenig and Marcel Dandois. June 17, 1948. 39p. diagrs., photos. (NACA RM E7L17)

Reports on investigation of variables pertinent to the control of gas temperatures during starting of gas-turbine engines. Results indicate that poor control of gas temperatures during starting is caused by an accumulation of fuel in the engine before ignition and by excessive fuel-flow rates at the time of ignition. Prompt ignition was obtained by use of well atomized fuel sprays.

NACA RM E7L18

VIBRATION OF TURBINE BLADES IN A TURBOJET ENGINE DURING OPERATION. W. C. Morgan, R. H. Kemp and S. S. Manson. April 22, 1948. 17p. diagrs., photos. (NACA RM E7L18)

An experimental investigation was made to determine the vibration phenomena that occur in gas-turbine blades during service operation. Through the use of high-temperature strain gages, vibratory phenomena in turbine blades were observed and evaluated in terms of modes, frequencies, and stress range. The frequencies of the principal vibrations were found to be related to the number of nozzle blades and combustion chambers.

NACA RM E7L30

COMBUSTION-EFFICIENCY AND ALTITUDE-LIMIT INVESTIGATIONS OF FIVE FUELS IN AN ANNULAR TURBOJET COMBUSTOR. Jerrold D. Wear and Edmund R. Jonash. June 7, 1948. 19p. diagrs. (NACA RM E7L30)

Five fuels of various boiling temperatures and various hydrocarbon types were investigated in a jet-propulsion annular combustor of 10-3/8 inch diameter to determine the effect of boiling temperature and paraffinic and aromatic hydrocarbon types on combustion efficiency and altitude operational limit at three inlet-air conditions. The performance difference among the fuels was greatest at inlet-air conditions characterized by unstable combustion.

NACA RM E8A28a

BENCH AND ENGINE OPERATION OF A FUEL-DISTRIBUTION CONTROL. Harold Gold and Robert J. Koenig. June 14, 1948. 34p. diagrs., photos. (NACA RM E8A28a)

Presents application of a fuel-distribution-control method to actual gas-turbine engine operation. The control used was designed to equalize the flow to the 14 nozzles of a gas-turbine engine. The maximum measured deviation from perfect distribution during engine operation was 3.8 percent. It was shown that the control model is capable of maintaining this accuracy independently of changes in fuel-nozzle resistances from 0 up to 1.46 times the resistance of a normal engine fuel nozzle.

NACA RM E8C02a

EFFECT OF FUELS AND FUEL-NOZZLE CHARACTERISTICS ON PERFORMANCE OF AN ANNULAR COMBUSTOR AT SIMULATED ALTITUDE CONDITIONS. Richard J. McCafferty. September 28, 1948. 90p. diagrs., photos., tab. (NACA RM E8C02a)

The effect of fuels and fuel-nozzle characteristics on performance of an annular combustor at simulated altitude conditions was determined by operating with different fuels and fuel-nozzle sizes with the combustor inlet-air conditions each independently altered near the altitude operational limits. Results indicate that amount of difference in performance at altitude among different fuels is determined by hydrocarbon type and fuel boiling points. Reduction in fuel-nozzle size increased combustion efficiency at low heat-input values but produced lower temperature-rise limits.

NACA RM E8C08

A FUEL-DISTRIBUTION CONTROL FOR GAS-TURBINE ENGINES. Harold Gold and David M. Straight. June 14, 1948. 17p. diagrs., photos. (NACA RM E8C08)

A device to control the distribution of fuel to any number of discharge nozzles of a gas-turbine engine is presented. A model of the device controlled the flow to four discharge nozzles within 2 percent of perfect distribution over a wide range of fuel flows and was unaffected by uneven discharge-nozzle pressures.

NACA RM E8D12

INVESTIGATION OF HIGH-TEMPERATURE OPERATION OF LIQUID-COOLED GAS TURBINES. I - TURBINE WHEEL OF ALUMINUM ALLOY, A HIGH-CONDUCTIVITY NONSTRATEGIC MATERIAL. Harry Kottas and Bob W. Sheflin. July 22, 1948. 15p. diagrs., photos., tab. (NACA RM E8D12)

A liquid-cooled gas turbine with aluminum-alloy blades and disk was built to investigate the effect of liquid cooling and high-conductivity metals on limiting turbine-inlet gas temperature. The turbine was successfully operated at a speed of 19,000 rpm and an inlet gas temperature of 2100° F.

NACA RM E8D14

GAS-TURBINE-ENGINE OPERATION WITH VARIABLE-AREA FUEL NOZZLE. Harold Gold and David M. Straight. July 9, 1948. 47p. diagrs., photos. (NACA RM E8D14)

The characteristics of variable-area and fixed-area atomizing nozzles are discussed in relation to use in aircraft gas-turbine engines. A variable-area nozzle and a fuel-distribution control that were used in the operation of a gas-turbine engine are described. When the engine was equipped with variable area fuel nozzles, thrust specific fuel consumption in the lower half of the fuel-flow range was reduced, fuel pressures were lowered in the upper half of the fuel-flow range, and starting characteristics were improved.

NACA RM E8D23

PERFORMANCE OF SEVERAL AIR EJECTORS WITH CONICAL MIXING SECTIONS AND SMALL SECONDARY FLOW RATES. S. C. Huddleston, H. D. Wilsted and C. W. Ellis. July 19, 1948. 74p. diagrs. (NACA RM E8D23)

Experimental results presented are limited to investigations of conical-type mixing-section ejectors at ratios of mixing-section minimum diameter to primary-jet-nozzle diameter of 1.21, 1.10, and 1.00 using unheated air. Results were cross-plotted in charts to show the performance of all ejectors within the range of configurations investigated. For diameter ratios of 1.21 and 1.10, the spacing giving maximum airflow varied with diameter ratio but did not vary with primary and secondary pressure ratios. In general, the ejector had little effect on the primary nozzle thrust.

NACA RM E8D29

EFFECT OF MACH NUMBER ON PERFORMANCE OF AN AXIAL-FLOW COMPRESSOR ROTOR-BLADE ROW. Paul D. Dugan, John J. Mahoney and William A. Benser. September 28, 1948. 27p. diagrs., photo. (NACA RM E8D29)

An investigation was conducted to study the influence of high relative inlet Mach number on the performance of a highly loaded rotor blade row. A range of weight flow was investigated for equivalent tip speeds ranging from 300 to 915 feet per second, which correspond to relative inlet Mach numbers of 0.30 to 0.90 at the mean radius. At high Mach numbers, above 0.70, the blade-section-performance results of this investigation indicated good correlation with low-speed cascade results. The efficiency gradually decreased from 0.950 to 0.915 as the relative inlet Mach number increased from 0.30 to 0.82.

NACA RM E8E10

ANALYTICAL INVESTIGATION OF EFFECT OF WATER-COOLED TURBINE BLADES ON PERFORMANCE OF TURBINE-PROPELLER POWER PLANTS. William D. Bowman. August 16, 1948. 67p. diagrs. (NACA RM E8E10)

Performance of six turbine-propeller power plants, each having a multistage turbine equipped with water-cooled turbine blades and designed for maximum turbine inlet temperatures of 2000°, 2500°, 3000°, 4000°, and 4500° R, respectively, is calculated over a range of flight speeds from 200 to 600 miles per hour at altitudes from sea level to 35,000 feet. High temperature operation possible with water-cooled blades yields, at appropriate pressure ratios, performance gains that are not vitiated by losses incurred in cooling process. The heat-exchanger capacity and size are approximately 20 percent of that of a liquid-cooled piston engine of equal rated power.

NACA RM E8F04

DESIGN AND PERFORMANCE OF EXPERIMENTAL AXIAL-DISCHARGE MIXED-FLOW COMPRESSOR. I - IMPELLER DESIGN THEORY. Arthur W. Goldstein. August 12, 1948. 32p. diagrs. (NACA RM E8F04)

An axial-discharge centrifugal compressor, especially adapted for jet engines because of the large mass flow per unit frontal area, is described. General equations of relative fluid motion are developed to show assumptions involved and empirical character of simplifications. The best impeller was selected on basis of maximum air-flow capacity, which was 19.6 pounds per second for 14-inch diameter with tip speed of 1480 feet per second and pressure ratio of 3.5.

NACA RM E8F09

ALTITUDE-WIND-TUNNEL INVESTIGATION OF A 4000-POUND-THRUST AXIAL-FLOW TURBOJET ENGINE. I - PERFORMANCE AND WINDMILLING DRAG CHARACTERISTICS. William A. Fleming. August 3, 1948. 76p. diagrs., photos. (NACA RM E8F09)

Performance of a 4000-pound-thrust axial-flow turbojet engine was investigated at altitudes from 5000 to 40,000 feet and at ram pressure ratios from 1.02 to 1.86. The specific fuel consumption based on net thrust horsepower decreased rapidly with airspeed. Windmilling drag of the engine was relatively high and the inlet should be closed when the engine is inoperative in flight. The results show that an accurate calculation of the jet thrust of the engine can be made from measurements of the temperatures and pressures obtained from a survey across the jet-nozzle exit.

NACA RM E8F09a

ALTITUDE-WIND-TUNNEL INVESTIGATION OF A 4000-POUND-THRUST AXIAL-FLOW TURBOJET ENGINE. II - OPERATIONAL CHARACTERISTICS. William A. Fleming. August 6, 1948. 53p. diagrs., photos., 3 tabs. (NACA RM E8F09a)

Operational characteristics of a 4000-pound-thrust axial-flow turbojet engine were obtained at pressure altitudes from 5000 to 50,000 feet, ram pressure ratios from 1.00 to 1.86, and temperatures from 60° to -50° F. The effects of altitude and airspeed on such operational characteristics as combustion stability acceleration, starting, and fuel-control system were studied. The engine could be operated at full speed without serious burner unbalance at altitudes up to 50,000 feet. Acceleration of the engine was relatively slow and the time required for acceleration increased with altitude. The engine started normally and easily below 20,000 feet.

NACA RM E8F09b

ALTITUDE-WIND-TUNNEL INVESTIGATION OF A 4000-POUND-THRUST AXIAL-FLOW TURBOJET ENGINE. III - PERFORMANCE CHARACTERISTICS WITH THE HIGH-FLOW COMPRESSOR. William A. Fleming and Richard L. Golladay. August 5, 1948. 69p. diagrs., photos. (NACA RM E8F09b)

An investigation was conducted to determine the performance of a 4000-pound-thrust axial-flow turbojet engine with a high-flow compressor at altitudes from 5000 to 40,000 feet and ram pressure ratios from 1.00 to 1.82. Engine performance with high-flow and low-flow (standard) compressors is compared. Installation of a high-flow compressor in the engine in place of a low-flow compressor at a corrected engine speed of 7600 rpm and a ram pressure ratio of 1.40 gave an increase in corrected jet thrust of 11 percent, in corrected net thrust of 6.5 percent, in corrected fuel consumption of 14 percent, and in corrected airflow of 12 percent.

NACA RM E8F09c

ALTITUDE-WIND-TUNNEL INVESTIGATION OF A 4000-POUND-THRUST AXIAL-FLOW TURBOJET ENGINE. IV - ANALYSIS OF COMPRESSOR PERFORMANCE. Robert O. Dietz, Jr. and Frank L. Suozzi. August 5, 1948. 54p. diagrs., photos., tab. (NACA RM E8F09c)

Performance of two 11-stage axial-flow compressors operating in a 4000-pound-thrust axial-flow turbojet engine was investigated at simulated altitudes from 5000 to 40,000 feet, ram pressure ratios from 1.00 to 1.86, and compressor Mach numbers from 0.24 to 0.95. One was a standard compressor and the other, a similar compressor except that the blade angles of the rotor and stator blades were increased about 5° to obtain greater airflow. Maximum adiabatic efficiency for both compressors was about 85 percent. Increasing the blade angles 5° increased the airflow approximately 10 percent. Efficiency and pressure ratio at a given compressor Mach number were unaffected by changes in Reynolds number.

NACA RM E8F09d

ALTITUDE-WIND-TUNNEL INVESTIGATION OF A 4000-POUND-THRUST AXIAL-FLOW TURBOJET ENGINE. V - ANALYSIS OF TURBINE PERFORMANCE. Richard P. Krebs and Reece V. Hensley. August 4, 1948. 27p. diagrs., photo. (NACA RM E8F09d)

Performance characteristics of a turbine from a 4000-pound-thrust axial-flow turbojet engine were obtained at altitudes from 5000 to 40,000 feet and at ram pressure ratios from 1.01 to 1.77. Turbine efficiency was practically unaffected by changes in altitude or ram pressure ratio. The maximum efficiency obtained was about 82 percent.

NACA RM E8F17

PERFORMANCE INVESTIGATION OF CAN-TYPE COMBUSTOR. I - INSTRUMENTATION, ALTITUDE OPERATIONAL LIMITS AND COMBUSTION EFFICIENCY. Eugene V. Zettle and William P. Cook. September 16, 1948. 21p. diagrs., photo., tab. (NACA RM E8F17)

Investigation of single can-type combustor of turbojet engine was conducted to determine altitude operational limits with two fuels, combustion efficiencies at various altitudes and engine speeds, combustor-outlet temperature distribution, and combustor total-pressure drop. Limits with AN-F-32 fuel were approximately 60,000 feet for engine speed of 6000 rpm and 38,000 feet for engine speed of 4000 rpm. Altitude operational limits with AN-F-32 fuel are higher over largest part of engine-speed range than with AN-F-28 fuel.

NACA RM E8F29

OPERATING TEMPERATURES OF I-40-5 TURBOJET ENGINE BURNER LINERS AND THE EFFECT OF TEMPERATURE VARIATION ON BURNER-LINER SERVICE LIFE. H. D. Wilsted, Robert T. Duffy and Ralph E. Grey. August 23, 1948. 25p. diagrs., photos. (NACA RM E8F29)

The metal temperature and the temperature distribution in an I-40-5 turbojet engine were determined over the operating range of engine speeds using thermocouples welded to the outer surface of the burner liner. A ceramic-coated thermocouple was used throughout the investigation. Burner-liner temperatures increased at an increasing rate with engine speed; the highest temperature recorded was 1500° F. Temperature gradients were as large as 700° F per inch. The high local temperature gradients were apparently the cause of short burner-liner service life.

NACA RM E8G02

INVESTIGATION OF THE I-40 JET-PROPULSION ENGINE IN THE CLEVELAND ALTITUDE WIND TUNNEL. I - PERFORMANCE AND WINDMILLING DRAG CHARACTERISTICS. Stanley L. Gendler and William K. Koffel. August 24, 1948. 75p. diagrs., photos. (NACA RM E8G02)

An altitude-wind-tunnel investigation of the performance and windmilling characteristics of an I-40 jet-propulsion engine was conducted over a range of simulated flight conditions to determine the effects of altitude and ram pressure ratio. The use of generalizing factors for estimating altitude performance of the engine gave only fair results. Specific fuel consumption based on net thrust horsepower showed no effect of altitude but decreased with increasing ram pressure ratio at an engine speed of 11,500 rpm.

NACA RM E8G02a

INVESTIGATION OF THE I-40 JET-PROPULSION ENGINE IN THE CLEVELAND ALTITUDE WIND TUNNEL. II - ANALYSIS OF COMPRESSOR PERFORMANCE CHARACTERISTICS. Robert O. Dietz, Jr. and Robert M. Geisenheyner. August 26, 1948. 28p. diagrs., photos. (NACA RM E8G02a)

Performance characteristics of a centrifugal compressor operating as an integral part of a jet propulsion engine were obtained for a range of compressor Mach numbers from 0.72 to 1.46, ram pressure ratios from 0.98 to 1.76, and simulated altitudes from 10,000 to 40,000 feet. From results obtained over a wide range of altitudes, it was determined that the compressor performance is primarily dependent on the compressor-inlet Mach number. Variations of Reynolds number of the air at the compressor inlet had little effect on compressor performance.

NACA RM E8G02b

INVESTIGATION OF THE I-40 JET-PROPULSION ENGINE IN THE CLEVELAND ALTITUDE WIND TUNNEL. III - ANALYSIS OF TURBINE PERFORMANCE AND EFFECT OF TAIL-PIPE DESIGN ON ENGINE PERFORMANCE. Richard P. Krebs and Frederick C. Foshag. August 26, 1948. 27p. diagrs., photo. (NACA RM E8G02b)

Performance characteristics of a turbine operating as an integral part of a jet-propulsion engine were determined for a range of simulated altitudes from 10,000 to 40,000 feet and ram pressure ratios from 0.98 to 1.76. A comparison of engine performance with three different tail pipes is also presented. Turbine efficiency was unaffected by changes in altitude or the tail-pipe designs but varied with changes in ram pressure ratio. The most satisfactory engine performance was obtained with a constant-diameter tail pipe having a short nozzle at the outlet.

NACA RM E8G02c

INVESTIGATION OF THE I-40 JET-PROPULSION ENGINE IN THE CLEVELAND ALTITUDE WIND TUNNEL. IV - ANALYSIS OF COMBUSTION-CHAMBER PERFORMANCE. Reece V. Hensley. August 25, 1948. 34p. diagrs. (NACA RM E8G02c)

Combustion-chamber performance characteristics have been determined from an I-40 jet-propulsion engine over a range of simulated altitudes and ram pressure ratios. Combustion efficiency varied directly with ram pressure ratio and engine speed and varied inversely with altitude. Percentage losses in total pressure were appreciably affected by changes in altitude or ram pressure ratio up to a value of 1.3.

NACA RM E8G02d

INVESTIGATION OF THE I-40 JET-PROPULSION ENGINE IN THE CLEVELAND ALTITUDE WIND TUNNEL. V - OPERATIONAL CHARACTERISTICS. Richard L. Golladay and Stanley L. Gendler. August 25, 1948. 71p. diagrs., photos., 6 tabs. (NACA RM E8G02d)

Operational characteristics of a jet-propulsion engine determined at pressure altitudes from 10,000 to 50,000 feet and ram pressure ratios from 1.00 to 1.76 include effects of altitude and airspeed on operating speed range, starting, windmilling, acceleration, speed regulation, cooling, and vibration of the standard and modified engines. Maximum engine speed was obtainable at all altitudes and airspeeds with each fuel-control system investigated. The maximum idling speed was raised by increases in altitude and airspeed. Ignition at 30,000 feet was difficult. Windmilling starts were not successful. The engine speed was held constant during simulated dives and climbs at constant throttle position.

NACA RM E8H11

THEORETICAL COMPARISON OF SEVERAL METHODS OF THRUST AUGMENTATION FOR TURBOJET ENGINES. Eldon W. Hall and E. Clinton Wilcox. October 27, 1948. 40p. diagrs. (NACA RM E8H11. Now issued as Rept. 992)

Performance of several methods of thrust augmentation for turbojet engines was calculated for flight Mach numbers from 0 to 2.5 and for altitudes of sea level and 35,332 feet. The methods investigated were tail-pipe burning, water injection at compressor inlet, combination of tail-pipe burning and water injection, bleedoff, and rocket assist. Results indicated that tail-pipe burning plus water injection was best for large amounts of thrust augmentation and tail-pipe burning was best for smaller amounts inasmuch as these methods have the lowest ratio of augmented-to-normal total liquid consumption for a given thrust increase.

NACA RM E8H12

DETERMINATION OF AVERAGE HEAT-TRANSFER COEFFICIENTS FOR A CASCADE OF SYMMETRICAL IMPULSE TURBINE BLADES. I - HEAT TRANSFER FROM BLADES TO COLD AIR. Gene L. Meyer. 41p. diagrs., photos. (NACA RM E8H12)

A cascade of symmetrical impulse turbine blades was investigated to determine average surface heat-transfer coefficients. The results were correlated with other cascade data for impulse blades and are presented in dimensionless form. Heat-transfer coefficients based on an effective gas temperature were independent of Mach number.

NACA RM E8I03

EFFECT OF PRESSURE RATIO AND INLET PRESSURE ON PERFORMANCE OF EXPERIMENTAL GAS TURBINE AT INLET TEMPERATURE OF 800° R. Robert C. Kohl and Robert G. Larkin. November 22, 1948. 7p. diagrs. (NACA RM E8I03)

An experimental gas turbine was operated over a range of blade-jet speed ratios, total pressure ratios, and inlet total pressures at a constant inlet temperature of 800° R. Peak over-all efficiencies were obtained at blade-jet speed ratios from 0.525 to 0.575 for all runs. The vartation in peak efficiency with inlet pressure and pressure ratio was of small magnitude for the conditions investigated.

NACA RM E8I21

SOME EFFECTS OF STATOR CONE ANGLE AND BLADE-TIP LEAKAGE ON 40-PERCENT-REACTION TURBINE HAVING ROTOR-BLADE CAPS. Robert E. English, Robert J. McCready and John S. McCarthy. March 23, 1949. 28p. diagrs., photo. (NACA RM E8I21)

A turbine having 40-percent reaction and rotor-blade caps, which form a continuous rotating cylindrical shroud, was operated with two stators having cone angles of 70° and 0° and with two stationary shrouds—a labyrinth, no-leakage shroud and a cylindrical shroud. With the 0°-cone-angle stator, the efficiency was 0.04 higher than with the 70°-cone-angle stator. Replacing the labyrinth shroud with the cylindrical shroud having a radial clearance 0.016 of the blade height produced no measurable change in efficiency.

NACA RM E8J22

VIBRATION SURVEY OF BLADES IN 10-STAGE AXIAL-FLOW COMPRESSOR. I - STATIC INVESTIGATION. Andre J. Meyer, Jr. and Howard F. Calvert. January 31, 1949. 34p. diagrs., photos., 2 tabs. (NACA RM E8J22)

Natural frequencies were measured in the blading of a 10-stage axial-flow compressor and these frequencies were compared with possible exciting forces. Node shapes of higher modes of vibration were determined from sand patterns in an attempt to correlate the position of high-stress points for the various modes with the location of actual failures in the seventh- and tenth-stage blades. Critical-speed diagrams were plotted to show possible cause of failures.

NACA RM E8J22a

VIBRATION SURVEY OF BLADES IN 10-STAGE AXIAL-FLOW COMPRESSOR. II - DYNAMIC INVESTIGATION. Andre J. Meyer, Jr. and Howard F. Calvert. January 31, 1949. 25p. diagrs., photos. (NACA RM E8J22a)

Vibratory stresses were measured in the first five stages by the use of strain gages mounted on the blades of a 10-stage axial-flow compressor. Effects of surge and of changes in pressure ratio on amplitude of blade vibrations were investigated. Good correlation was obtained between first bending-mode frequencies that were dynamically measured and those that were calculated by correcting static measurements to account for the effects of centrifugal force.

NACA RM E8J22b

VIBRATION SURVEY OF BLADES IN 10-STAGE AXIAL-FLOW COMPRESSOR. III - PRELIMINARY ENGINE INVESTIGATION. Andre J. Meyer, Jr. and Howard F. Calvert. January 31, 1949. 23p. diagrs., photo. (NACA RM E8J22b)

Vibratory stresses were measured in the blading of a 10-stage axial-flow compressor under operating conditions. Curves are presented showing maximum allowable vibratory stress for a given speed, change of damping coefficient with mounting of a strain gage at base of blade, effect of rotor speed on blade natural frequency, and effect of order of the first bending-mode vibration on stress. For all stages, the lower the order of vibration the higher the stress but no destructive vibrations were detected.

NACA RM E8J25

ALTITUDE-WIND-TUNNEL INVESTIGATION OF OPERATIONAL CHARACTERISTICS OF WESTINGHOUSE X24C-4B AXIAL-FLOW TURBOJET ENGINE. W. Kent Hawkins and Carl L. Meyer. November 23, 1948. 39p. diagrs., photos. (NACA RM E8J25)

Operating characteristics of Westinghouse X24C-4B axial-flow turbojet engine presented include: Operable engine-speed range at altitude, acceleration and deceleration, altitude and flight-Mach-number compensation of governor, lubrication-system performance, and starting characteristics. Operable range of engine speeds was limited at high altitudes and low flight Mach numbers. Accelerations and decelerations at altitudes above 25,000 feet were limited by combustion blow-out. Altitude and flight-Mach-number compensation of governor was good at high engine speeds and starting characteristics of one engine configuration were very unsatisfactory.

NACA RM E8J25a

ALTITUDE-WIND-TUNNEL INVESTIGATION OF PERFORMANCE AND WINDMILLING DRAG CHARACTERISTICS OF WESTINGHOUSE X24C-4B AXIAL-FLOW TURBOJET ENGINE. Carl L. Meyer and Harry E. Bloomer. November 23, 1948. 60p. diagrs., photo. (NACA RM E8J25a)

An altitude-wind-tunnel investigation of the performance and windmilling drag characteristics of an original and a modified turbojet engine was conducted over a range of simulated flight conditions. Performance variables depending upon fuel consumption that are obtained from data at one altitude cannot be used to predict these variables at other altitudes; however, thrust and air-flow values can be predicted for a limited range of altitudes from data taken at one altitude. The maximum net thrust of the modified engine was 3 to 20 percent greater than that of the original engine. The windmilling engine speed and drag of the two engines were comparable.

NACA RM E8J25d

INVESTIGATION OF PERFORMANCE OF TURBOJET ENGINE WITH CONSTANT- AND VARIABLE-AREA EXHAUST NOZZLES. Lewis E. Wallner. November 26, 1948. 43p. diagrs., photos., tab. (NACA RM E8J25d)

Presents performance of turbojet engine with constant- and variable-area exhaust nozzles at simulated altitudes from 5000 to 45,000 feet and simulated flight Mach numbers from 0.12 to 0.94. The efficiency of the variable-area nozzle investigated was 1.5 to 8 percent lower than the efficiency of the constant-area nozzle. As a result, lower thrusts and specific fuel consumptions were obtained with the variable-area nozzle as compared to the constant-area nozzle.

NACA RM E8J25e

ALTITUDE-WIND-TUNNEL INVESTIGATION OF TAIL-PIPE BURNING WITH A WESTINGHOUSE X24C-4B AXIAL-FLOW TURBOJET ENGINE. William A. Fleming and Lewis E. Wallner. December 13, 1948. 56p. diagrs., photos., tab. (NACA RM E8J25e)

Thrust augmentation of a 3000-pound-thrust axial-flow type turbojet engine by burning fuel in the tail pipe has been investigated in the NACA Cleveland altitude wind tunnel. The highest net-thrust increase obtained in the investigation was 86 percent with a net thrust specific fuel consumption of 2.91 and a total fuel-air ratio of 0.0523. The highest combustion efficiencies obtained with each of the four configurations investigated ranged from 0.71 to 0.96.

NACA RM E8J28

ALTITUDE-WIND-TUNNEL INVESTIGATION OF WESTINGHOUSE 19B-2, 19B-8, AND 19XB-1 JET-PROPULSION ENGINES. I - OPERATIONAL CHARACTERISTICS. William A. Fleming. 21p. diagrs., photos. (NACA RM E8J28)

Operational characteristics of the 19B-2, 19B-8, and 19XB-1 turbojet engines discussed include effects of altitude and airspeed on operating range, combustion stability, starting, acceleration, and functioning of fuel-control system. Operation of 19B engines above an altitude of 17,000 feet was limited because of combustion blow-out; operational range of the 19XB-1 engine was slightly better than that of 19B engines. Starting characteristics of the 19XB-1 engine were satisfactory but 19B engines did not start consistently.

NACA RM E8J28a

ALTITUDE-WIND-TUNNEL INVESTIGATION OF WESTINGHOUSE 19B-2, 19B-8, AND 19XB-1 JET-PROPULSION ENGINES. II - ANALYSIS OF TURBINE PERFORMANCE OF 19B-8 ENGINE. Richard P. Krebs and Frank L. Suozzi. November 24, 1948. 27p. diagrs., photos. (NACA RM E8J28a)

The performance of the turbine of the 19B-8 turbojet engine was determined from an investigation of the complete engine in the altitude wind tunnel over a range of simulated flight conditions. The effects of altitude, flight Mach number, and tail-cone position on turbine performance are discussed. Turbine efficiency was unaffected by changes in altitude up to 15,000 feet but was a function of tail-cone position and flight Mach number.

NACA RM E8J28b

ALTITUDE-WIND-TUNNEL INVESTIGATION OF WESTINGHOUSE 19B-2, 19B-8, AND 19XB-1 JET-PROPULSION ENGINES. III - PERFORMANCE AND WINDMILLING DRAG CHARACTERISTICS. William A. Fleming and Robert O. Dietz, Jr. November 26, 1948. 71p. diagrs., photos. (NACA RM E8J28b)

Performance of the 19B-8 and 19XB-1 turbojet engines and windmilling drag of the 19B-8 engine were determined in the altitude wind tunnel for a range of simulated flight conditions. Performance variables involving fuel consumption that are obtained from data at one altitude cannot be used to predict these variables at altitudes above 15,000 feet; thrust and air-flow values can be predicted for the range of altitudes investigated from data taken at one altitude. At similar operating conditions, corrected values of jet thrust and air flow were approximately the same for both engines.

NACA RM E8J28c

ALTITUDE-WIND-TUNNEL INVESTIGATION OF WESTINGHOUSE 19B-2, 19B-8, AND 19XB-1 JET-PROPULSION ENGINES. IV - ANALYSIS OF COMPRESSOR PERFORMANCE. Robert O. Dietz and John K. Kuenzig. November 26, 1948. 48p. diagrs., photos. (NACA RM E8J28c)

Performance of the compressors of the 19B-8 and 19XB-1 turbojet engines was determined from an investigation of the complete engines over a range of simulated flight conditions. For the range of compressor operation investigated, Reynolds number had no measurable effect on compressor performance. The operating lines of the 19B-8 compressor were on the low-air-flow side of the region of maximum efficiency. The pressure ratio of the 19XB-1 compressor was higher than that of the 19B-8 compressor.

NACA RM E8J28d

ALTITUDE-WIND-TUNNEL INVESTIGATION OF WESTINGHOUSE 19B-2, 19B-8, AND 19XB-1 JET-PROPULSION ENGINES. V - COMBUSTION-CHAMBER PERFORMANCE. Bemrose Boyd. November 26, 1948. 41p. diagrs., photo. (NACA RM E8J28d)

Combustion-chamber pressure losses of the 19B-2 and 19B-8 turbojet engines and combustion efficiencies of these two engines and the 19XB-1 turbojet engine are presented. Data were obtained from investigation of the complete engine over a range of simulated flight conditions. Maximum combustion efficiency was shifted to higher engine speeds by increasing altitude. Combustion efficiency was decreased at low engine speeds by increasing tunnel Mach number and was decreased at high engine speeds by extension of the tail cone.

NACA RM E8J29

SIMULATED ALTITUDE PERFORMANCE OF COMBUSTOR OF WESTINGHOUSE 19XB-1 JET-PROPULSION ENGINE. J. Howard Childs and Richard J. McCafferty. November 30, 1948. 44p. diagrs., photo., 2 tabs. (NACA RM E8J29)

A 19XB-1 combustor was operated under conditions simulating zero-ram operation of the 19XB-1 turbojet engine at various altitudes and engine speeds. The combustion efficiencies and the altitude operational limits were determined; data were also obtained on the character of the combustion, the pressure drop through the combustor, and the combustor outlet temperature and velocity profiles.

NACA RM E8K22

CARBON DEPOSITION OF 19 FUELS IN AN ANNULAR TURBOJET COMBUSTOR. Jerrold D. Wear and Edmund R. Jonash. February 3, 1949. 21p. diagrs., 2 tabs. (NACA RM E8K22)

Effects of fuel properties and change in simulated engine operating conditions on carbon deposition were evaluated in an annular turbojet combustor with a diameter of 10-3/8 inches. The fuels included hydrocarbons of the paraffinic, olefinic, and aromatic types as well as fuel mixtures. Carbon deposition increased with increase in boiling temperature of fuels of the same hydrocarbon type. Aromatic fuels deposited more carbon than the other types of fuel of the same boiling temperature. An empirical correlation of the carbon deposition and the boiling temperature and hydrogen-carbon weight ratio of the fuel was obtained.

NACA RM E8L02

COMPARISON OF FLIGHT PERFORMANCE OF AN-F-58 AND AN-F-32 FUELS IN J35 TURBOJET ENGINE. Loren W. Acker and Kenneth S. Kleinknecht. April 7, 1949. 15p. diagrs., photo., 2 tabs. (NACA RM E8L02)

Performance of fuels corresponding to specifications AN-F-58 and AN-F-32 was investigated in a J35 turbojet engine in flight. Comparatively, AN-F-58 fuel indicated slightly higher net thrust and fuel consumption, inferior blowout limits, and similar altitude starting characteristics and carbon deposits.

NACA RM E8L20a

ALTITUDE PERFORMANCE OF AN-F-58 FUELS IN J35-C-3 SINGLE COMBUSTOR. Edward G. Stricker and Warren D. Rayle. June 14, 1949. 21p. diagrs., 2 tabs. (NACA RM E8L20a)

Three fuel blends conforming to AN-F-58 specifications were tested in order to determine the influence of boiling temperatures and aromatic content on altitude performance in single combustor of 4000-pound-thrust turbojet engine. At simulated engine conditions from an altitude of 30,000 to an altitude of 60,000 feet and 85-percent rated engine speed, the three AN-F-58 fuels showed little difference in performance.

NACA RM E9B02

INVESTIGATION OF SEVERAL CLAMSHELL VARIABLE-AREA EXHAUST NOZZLES FOR TURBOJET ENGINES. Bruce T. Lundin. May 26, 1949. 52p. diagrs., photos. (NACA RM E9B02)

Efficiency of five different types of clamshell variable area exhaust nozzle for turbojet engines is compared with performance of various conventional fixed-area conical nozzles. Variable-area nozzles had satisfactory mechanical reliability even under afterburning conditions and three of the nozzles investigated provided jet thrust within 0 to 1-1/2 percent of that obtained with the fixed-area nozzles. Larger thrust losses for the other two nozzles were attributed principally to a nonplanar outlet configuration of the movable nozzle flaps.

NACA RM E9C15

TURBINE-ROTOR-BLADE DESIGNS BASED ON ONE-DIMENSIONAL-FLOW THEORY. I - PERFORMANCE OF SINGLE-STAGE TURBINE HAVING 40-PERCENT REACTION. Robert E. English and Cavour H. Hauser. June 10, 1949. 31p. diagrs., photo. (NACA RM E9C15)

The performance of the first of a family of turbine-rotor-blade designs is presented. The rotor blade was designed for a total-to-static pressure ratio of 4.00 and 40-percent reaction using one-dimensional-flow theory. Constant static pressure was assumed over the blade height at the entrance and the exit of each row of blades. The brake internal efficiency had a maximum value slightly greater than 0.84 and was equal to 0.82 at design conditions. For design conditions, the static pressure varied 5 percent over the blade height at the rotor exit.

NACA RM E9D01

EVALUATION OF PISTON-TYPE GAS-GENERATOR ENGINE FOR SUBSONIC TRANSPORT OPERATION. A. F. Lietzke and Hugh M. Henneberry. July 15, 1949. 29p. diagrs., tab. (NACA RM E9D01)

A piston-type gas-generator engine was evaluated by comparing performances of a transport airplane powered by this engine with an airplane having same characteristics powered by other types of engine. Turbojet, turbine-propeller, compound, and turbo-supercharged reciprocating engine were compared with gas-generator engine. Comparison is based on pay-load ton-miles per hour operation per ton take-off gross weight. Gas-generator engine was found to have a marked advantage over other engine types for long range at subsonic flight speeds. At short ranges no one engine showed great superiority, but the turbojet engine exhibits some advantages at high velocity.

NACA RM E9E16

EFFECT OF TEMPERATURE ON PERFORMANCE OF SEVERAL EJECTOR CONFIGURATIONS. H. D. Wilsted, S. C. Huddleston and C. W. Ellis. June 13, 1949. 27p. diagrs. (NACA RM E9E16)

An investigation was made to determine the effect of the primary-jet temperature on the performance of several ejector configurations. In general, for ejectors with short straight mixing lengths and short spacings, weight-flow ratio varies directly as the square root of ratio of total primary temperature to total secondary temperature. For ejectors with longer lengths and spacings, which pump greater weight flows through the secondary annulus, however, the pressure increase in the plane of the primary nozzle exit decreases secondary weight flow so much that the temperature-ratio correction factor does not completely describe temperature effect on ejector performance.

NACA RM E9G01

PROPERTIES OF CERTAIN INTERMETALLICS AS RELATED TO ELEVATED-TEMPERATURE APPLICATIONS. I - MOLYBDENUM DISILICIDE. W. A. Maxwell. October 6, 1949. 27p. diagrs., 4 tabs. (NACA RM E9G01)

Methods were developed for the preparation, purification, and formation by pressing and sintering of molybdenum disilicide. The modulus-of-rupture strength and oxidation resistance at 2000° and 2400° F were studied as well as the general properties. Sintered molybdenum disilicide was found to have high comparative strength at 2400° F and to possess exceptional resistance to oxidation at high temperatures. The material deformed plastically at temperatures well below the melting point despite complete brittle behavior at room temperature.

NACA RM E9G08

ALTITUDE PERFORMANCE AND OPERATIONAL CHARACTERISTICS OF 29-INCH-DIAMETER TAIL-PIPE BURNER WITH SEVERAL FUEL SYSTEMS AND FLAME HOLDERS ON J35 TURBOJET ENGINE. E. William Conrad and William R. Prince. November 8, 1949. 50p. diagrs., photos., tab. (NACA RM E9G08)

An investigation of afterburning was conducted in the Lewis altitude wind tunnel using a full-scale turbojet engine to obtain information on afterburner design variables. Radial distribution and direction of injection of the tail-pipe fuel and several flame-holder types were studied. Direction of fuel injection had no effect on combustion efficiency; however, poor radial fuel distribution resulted in low combustion efficiencies. As altitude was increased, the decrease in peak combustion efficiency became more rapid as the blocking area of the flame holder was reduced. Problems of tail-pipe cooling and ignition are discussed and satisfactory solutions obtained.

NACA RM E9G13

CYCLIC ENGINE OPERATION OF CAST VITALLIUM TURBINE BLADES AT AN EXHAUST-CONE GAS TEMPERATURE OF 1440 ± 20° F. Charles Yaker and Floyd B. Garrett. September 19, 1949. 41p. diagrs., photos., 4 tabs. (NACA RM E9G13)

An investigation was conducted to study engine performance of cast Vitallium turbine blades at an estimated maximum blade temperature of 1600° F. The blades, mounted in a Timken 16-25-6 wheel, were subjected to 20-minute cycles consisting of approximately 5 minutes at idle and 15 minutes at rated speed. After 7-1/2 cycles (2 hr, 30 min), one

blade fractured due to fatigue, a large number of blades had intercrystalline cracks, and two blades had large transcrystalline cracks. Examination of broken and unbroken blades disclosed no correlation between blade failure and elongation as compared with grain size and hardness.

NACA RM E9G25

VIBRATIONAL MODES OF SEVERAL HOLLOW TURBINE BLADES AND OF SOLID TURBINE BLADE OF SIMILAR AERODYNAMIC DESIGN. R. H. Kemp and J. Shifman. October 3, 1949. 17p. diagrs., photos. (NACA RM E9G25)

Vibrational modes of several hollow turbine blades and a solid turbine blade of similar aerodynamic design were experimentally determined. Most of the observed vibrational modes of the hollow blades could be excited if the blades were operated in a conventional turbojet engine. A breathing effect was found in hollow blades at approximately 1230 cycles per second in which the blade walls moved toward each other and then away, producing stress concentrations at the leading and trailing edges. Little similarity in vibrational modes existed between the hollow blades and the solid blade. Approximately twice as many readily excited modes were found in the hollow blades as in the solid blade.

NACA RM E9I07

VIBRATION OF LOOSELY MOUNTED TURBINE BLADES DURING SERVICE OPERATION OF A TURBOJET ENGINE WITH CENTRIFUGAL COMPRESSOR AND STRAIGHT-FLOW COMBUSTION CHAMBERS. W. C. Morgan, R. H. Kemp and S. S. Manson. November 3, 1949. 18p. diagrs., photos. (NACA RM E9I07)

Vibration characteristics of loosely mounted turbine blades were determined during service operation of a turbojet engine. High-temperature strain gages were used to measure turbine-blade vibrations. Vibration occurred in first bending and first torsional modes; in addition, a small number of complex-mode vibrations was observed. Comparison was made between vibrations in loosely mounted blades and those observed during a previous investigation of similar blades tightly mounted in a turbine wheel. The comparison did not indicate that any considerable gain in damping was effected by the use of loosely mounted blades.

NACA RM E9I23

ALTITUDE-CHAMBER PERFORMANCE OF BRITISH ROLLS-ROYCE NENE II ENGINE. I - STANDARD 18.75-INCH-DIAMETER JET NOZZLE. Zelmar Barson and H. D. Wilsted. September 23, 1949. 58p. diagrs., 2 tabs. (NACA RM E9I23)

An altitude-chamber investigation of the British Rolls-Royce Nene II turbojet engine was conducted over a range of altitudes from sea level to 60,000 feet and ram-pressure ratios from 1.00 to 3.50. Decreasing compressor pressure ratio and efficiency at high altitude prevented prediction of engine performance parameters for altitudes above 20,000 feet from data obtained at any one altitude. Engine performance generalized to a single curve for ram-pressure ratio for all conditions when critical flow existed in the jet nozzle.

NACA RM E9K04

CORRELATION OF LABORATORY SMOKE TEST WITH CARBON DEPOSITION IN TURBOJET COMBUSTORS. Arthur M. Busch. February 3, 1950. 15p. diagrs., 3 tabs. (NACA RM E9K04)

A function of flame heights at the sooting point in a simple wick lamp and boiling point of 19 fuels was correlated with carbon deposition in a 10-3/8 inch annular turbojet combustor operating at a single set of conditions. Two similar investigations with different combustors, operating conditions, and nine different fuels yielded similar correlations. The simple wick lamp may be of value in the evaluation of turbojet fuels.

NACA RM E9L05

EFFECTS OF OBSTRUCTIONS IN COMPRESSOR INLET ON BLADE VIBRATION IN 10-STAGE AXIAL-FLOW COMPRESSOR. Andre J. Meyer, Jr., Howard F. Calvert and C. Robert Morse. February 13, 1950. 16p. diagrs. (NACA RM E9L05)

Resistance-wire strain gages were used to measure blade-vibration characteristics in 10-stage axial-flow compressor during normal jet-engine operation. Effects produced by obstructions in path of air flow entering compressor were also investigated. Aerodynamic damping of vibrating blades was evaluated. Results indicated that obstructions affected blade vibrations throughout compressor, that obstructions could be so located as to reduce some vibrations, and that aerodynamic damping accounted for about four-fifths of total dynamic blade damping.

NACA RM L6J09

HIGH-SPEED WIND-TUNNEL TESTS OF A 1/16-SCALE MODEL OF THE D-558 RESEARCH AIRPLANE. LIFT AND DRAG CHARACTERISTICS OF THE D-558-I AND VARIOUS WING AND TAIL CONFIGURATIONS. John B. Wright and Donald L. Loving. April 18, 1947. 43p. diagrs., 2 tabs. (NACA RM L6J09)

Test results indicated the airplane will have satisfactory lift and drag characteristics up to and including the design Mach number of 0.85. The swept-wing and low-aspect-ratio wing configurations showed pronounced improvement in maintaining lift throughout the Mach number range tested and in increasing critical Mach numbers to the order of 0.9.

NACA RM L6K08

RESUME OF WIND-TUNNEL DATA ON THE EFFECT OF EXTERNAL STORES ON STABILITY OF MODELS OF MILITARY AIRPLANES. H. Norman Silvers and Raymond D. Vogler. December 19, 1946. 7p. 2 tabs. (NACA RM L6K08)

A summary, in tabular form, is presented on the effect on static stability of tanks, torpedoes, bombs, and radar domes. The data obtained indicate that at Mach numbers below 0.4 the effects of external stores on static longitudinal stability were small but may not be negligible. Although data were meager for Mach numbers above 0.4, results indicated that wing-tip tanks which were well faired to the wing contour caused reasonably small changes in static longitudinal stability. The available data were insufficient to estimate the general effects of external stores on lateral stability.

NACA RM L6K08b

PRELIMINARY TESTS OF A BURNER FOR RAM-JET APPLICATIONS. Paul W. Huber. January 15, 1947. 14p. diagrs. (NACA RM L6K08b)

Preliminary tests of a small ram-jet burner have been made and tests of this burner indicate efficient combustion characteristics (combustion was 80 percent complete) and low aerodynamic losses at the conditions tested. The fact that the measured combustion was so nearly complete is due mainly to the method of fuel injection and to mixing of fuel and air before ignition. The pressure drop due to frictional losses at the burner at the inner passage of the ram jet is small, since the air is not greatly disturbed to obtain mixing and ignition.

NACA RM L6L19

THE EFFECT OF HIGH SOLIDITY ON PROPELLER CHARACTERISTICS AT HIGH FORWARD SPEEDS FROM WIND-TUNNEL TESTS OF THE NACA 4-(3)(06.3)-06 AND NACA 4-(3)(06.4)-09 TWO-BLADE PROPELLERS. James B. Delano. February 27, 1947. 50p. diagrs., photos. (NACA RM L6L19)

Two two-blade propellers were tested in the Langley 8-foot high-speed tunnel through a range of blade angle from 20° to 70° for free-stream Mach numbers from 0.165 to 0.725 to determine the effects of high solidity and compressibility on propeller characteristics.

NACA RM L6L27

EFFECTS OF A FUSELAGE AND VARIOUS HIGH-LIFT AND STALL-CONTROL FLAPS ON AERODYNAMIC CHARACTERISTICS IN PITCH OF AN NACA 64-SERIES 40° SWEPT-BACK WING. D. William Conner and Robert H. Neely. May 26, 1947. 40p. diagrs., photos., tab. (NACA RM L6L27)

Wind-tunnel tests were made to determine low-speed lift, drag, and pitching-moment characteristics. The wing had an aspect ratio of 4 and a taper ratio of 0.625. Low-, middle-, and high-wing-fuselage combinations were tested at Reynolds numbers of 3×10^6 and 8.1×10^6.

NACA RM L7C11

AERODYNAMIC CHARACTERISTICS OF A 45° SWEPT-BACK WING WITH ASPECT RATIO OF 3.5 AND NACA 2S-50(05)-50(05) AIRFOIL SECTIONS. Anthony J. Proterra. August 4, 1947. 21p. diagrs., photo. (NACA RM L7C11)

Scale effects were investigated at Reynolds numbers ranging from 2.1×10^6 to 8.0×10^6; the effects of yaw were investigated at a Reynolds number of 4.1×10^6. Results indicate that the wing has poor characteristics from low-speed considerations.

NACA RM L7C24a

INVESTIGATION OF INTAKE DUCTS FOR A HIGH-SPEED SUBSONIC JET-PROPELLED AIRPLANE. Herbert N. Cohen. April 23, 1947. 24p. diagrs., photos., tab. (NACA RM L7C24a)

Results of pressure-loss measurements are presented for full-scale models of two ducts under consideration for use in the induction system of an experimental jet-propelled airplane. Supplementary pressure-loss measurements were made on the better of the two ducts, designated duct II, first with carborundum grains in the duct inlet and then with a spoiler in order to obtain an indication of the importance of inlet roughness and surface discontinuities. Additional measurements were made of duct II incorporating a horizontal "splitter" vane which was under consideration for structural reasons.

NACA RM L7D03

AN INVESTIGATION OF THE LOW-SPEED CHARACTERISTICS OF TWO SHARP-EDGE SUPERSONIC INLETS DESIGNED FOR ESSENTIALLY EXTERNAL SUPERSONIC COMPRESSION. John S. Dennard. June 6, 1947. 32p. diagrs., photos. (NACA RM L7D03)

The investigation has been conducted at low airspeeds to obtain preliminary information concerning the surface-pressure, drag, and pressure recovery of such inlets. Surface-pressure measurements and surveys of the pressures in the internal and external flow were obtained at angles of attack of 0° and 6° for a wide range of inlet-velocity ratio.

NACA RM L7D14

AERODYNAMIC CHARACTERISTICS OF A 42° SWEPT-BACK WING WITH ASPECT RATIO 4 AND NACA 64_1-112 AIRFOIL SECTIONS AT REYNOLDS NUMBERS FROM 1,700,000 TO 9,500,000. Robert H. Neely and D. William Conner. May 23, 1947. 39p. diagrs., photos. (NACA RM L7D14)

Wind-tunnel tests were made to determine low-speed aerodynamic characteristics in pitch and in yaw at high Reynolds numbers. The characteristics in pitch were obtained over a Reynolds number range from 1.7×10^6 to 9.5×10^6 and the characteristics in yaw from 1.7×10^6 to 5.3×10^6.

NACA RM L7E12

FURTHER INVESTIGATION OF NACA 4-(5)(08)-03 TWO-BLADE PROPELLER AT HIGH FORWARD SPEEDS. Melvin M. Carmel and Harold L. Robinson. May 26, 1947. 46p. diagrs. (NACA RM L7E12)

Tests of an NACA two-blade propeller have been made in the Langley 8-foot high-speed tunnel for blade angles of 45° and 60° extending the Mach number range from that of previous tests of this propeller up to a forward Mach number of 0.913.

NACA RM L7E13

EFFECTS OF A FUSELAGE ON THE AERODYNAMIC CHARACTERISTICS OF A 42° SWEPTBACK WING AT REYNOLDS NUMBERS TO 8,000,000. Reino J. Salmi, D. William Conner and Robert R. Graham. June 10, 1947. 32p. diagrs., photos. (NACA RM L7E13)

Tests were made in pitch at Reynolds numbers of 3,040,000 and 8,090,000 and in yaw at Reynolds numbers of 1,720,000 and 5,300,000. The wing had an aspect ratio of 4, a taper ratio of 0.625 and NACA 64_1-112 airfoil sections. Tests were made with the wing in high-, low-, and midwing positions. Tests were made without flaps and with 18.4-percent-chord split flaps extending from 12.3 to 50 percent of the semispan. The presence of the fuselage had little effect on the values of the maximum lift coefficient and the slope of the lift curve, but caused a destabilizing shift in the rate of change of pitching moment with lift.

NACA RM L7E23

LOW-SPEED CHARACTERISTICS IN PITCH OF A 42° SWEPTBACK WING WITH ASPECT RATIO 3.9 AND CIRCULAR-ARC AIRFOIL SECTIONS. Robert H. Neely and William Koven. November 13, 1947. 42p. diagrs., photos., 2 tabs. (NACA RM L7E23)

Characteristics of basic wing were poor. The effects on the wing characteristics of extensible round-nose leading-edge flaps located on the outboard 70 percent of the semispan, and of a fuselage with fineness ratio 10.2 located in the low, middle, and high positions were investigated. Tests covered a range of Reynolds numbers from 3.09×10^6 to 9.60×10^6.

NACA RM L7E29

ESTIMATION OF RANGE OF STABILITY DERIVATIVES FOR CURRENT AND FUTURE PILOTLESS AIRCRAFT. Marvin Pitkin and Herman O. Ankenbruck. October 8, 1947. 22p. diagrs., tab. (NACA RM L7E29)

The estimated range of the aerodynamic and mass stability derivatives for airplanes and missiles is given primarily as an aid to designers of "flight tables" and "simulators."

NACA RM L7F04a

LOW-SPEED CHARACTERISTICS IN PITCH OF A 34° SWEPTFORWARD WING WITH CIRCULAR-ARC AIRFOIL SECTIONS. D. William Conner and Patrick A. Cancro. January 9, 1948, 35p. diagrs., photos. (NACA RM L7F04a)

Contains low-speed lift, drag, and pitching-moment characteristics of a 34° sweptforward wing with aspect ratio 3.9 and circular-arc airfoil sections tested with a fuselage and high-lift and stall-control devices. Adding a fuselage to the basic wing reduced the undesirable variations in pitching moment in the high-lift range. Adding full-span, extended, round-nose, leading-edge flaps to the midwing-fuselage combination increased the maximum lift coefficient to 1.30 without seriously decreasing the longitudinal stability. Combinations with half-span split flaps had unfavorable pitching-moment characteristics.

NACA RM L7F13

MEASUREMENTS OF AERODYNAMIC CHARACTERISTICS OF A 35° SWEPTBACK NACA 65-009 AIRFOIL MODEL WITH 1/4-CHORD PLAIN FLAP BY THE NACA WING-FLOW METHOD. Harold I. Johnson. August 5, 1947. 72p. diagrs., photos. (NACA RM L7F13)

As part of a general investigation of the stability and control characteristics of various airfoil-flap combinations in the transonic speed range, measurements were made by the NACA wing-flow method of the lift, pitching-moment, and hinge-moment characteristics of a 35° sweptback NACA 65-009 airfoil of aspect ratio 3.04, with a full-span 1/4-chord unsealed plain flap. The tests covered Mach numbers from 0.55 to 1.10, Reynolds numbers from about 500,000 to 1,300,000, angles of attack from -2° to 15°, and flap deflections from about -20° to 20°.

NACA RM L7F16

LANGLEY FULL-SCALE-TUNNEL INVESTIGATION OF MAXIMUM LIFT AND STABILITY CHARACTERISTICS OF AN AIRPLANE HAVING APPROXIMATELY TRIANGULAR PLAN FORM (DM-1 GLIDER). J. Calvin Lovell and Herbert A. Wilson, Jr. August 5, 1947. 44p. diagrs., photos., tab. (NACA RM L7F16)

This glider had an aspect ratio of 1.8 and 60° sweepback. The investigation consisted of the determination of the separate effects of the following modifications made to the glider on its maximum lift and stability characteristics: (a) installation of sharp leading edges over the inboard semispan of the wing, (b) removal of the vertical fin, (c) sealing of the elevon control-balance slots, (d) installation of redesigned thin vertical surfaces, (e) installation of faired sharp leading edges, and (f) installation of canopy.

NACA RM L7F19

PRELIMINARY INVESTIGATION OF SPOILER LATERAL CONTROL ON A 42° SWEPTBACK WING AT TRANSONIC SPEEDS. Leslie E. Schneiter and Howard L. Ziff. August 12, 1947. 13p. diagrs. (NACA RM L7F19)

This investigation was performed on a double-wedge type semispan wing by the NACA wing-flow method of testing. Above a Mach number of 0.6, the effectiveness of the spoiler in producing rolling moment at an angle of attack of 3° increased as a Mach number of 0.90 was approached. At Mach numbers greater than 0.90, the spoiler effectiveness decreased rapidly until a Mach number of 1.05 was attained, above which point the effectiveness increased slightly as speed was further increased.

NACA RM L7I24

AN ANALYSIS OF DUCTED-AIRFOIL RAM JETS FOR SUPERSONIC AIRCRAFT. Paul R. Hill and A. A. Gammal. July 7, 1948. 43p. diagrs. (NACA RM L7I24)

The effect of sweepback on the external aerodynamics of ducted airfoils with the leading edge ahead of the Mach cone is shown to be small. Possible total pressure recoveries are determined for two-dimensional wedge-type diffuser inlets in order to compute thrust and propulsive coefficients for a wide range of hydrocarbon fuel-air ratios. The possible range and acceleration performances are determined for aircraft with fineness ratio 10, parabolic body-of-revolution fuselages with both ducted wing and ducted tails of various sizes relative to the fuselage size.

NACA RM L7I30

YAW CHARACTERISTICS AND SIDEWASH ANGLES OF A 42° SWEPTBACK CIRCULAR-ARC WING WITH A FUSELAGE AND WITH LEADING-EDGE AND SPLIT FLAPS AT A REYNOLDS NUMBER OF 5,300,000. Reino J. Salmi and James E. Fitzpatrick. December 10, 1947. 38p. diagrs., photos., tab. (NACA RM L7I30)

Contains results of tests of a 42° sweptback wing at a Mach number of 0.11. The dihedral effect of the sharp-edged-airfoil wing became negative at moderate lift coefficients similar to low Reynolds number results of round-nosed airfoil wings. Flap deflection produced positive effective dihedral. The plain wing had neutral directional stability with flaps neutral but was stable with flaps deflected. Air-stream surveys of the sidewash angles of various wing fuselage combinations showed that maximum vertical-tail effectiveness would be obtained on a low-wing combination.

NACA RM L7J03

INVESTIGATION OF PRESSURE DISTRIBUTION OVER AN EXTENDED LEADING-EDGE FLAP ON A 42° SWEPTBACK WING. D. William Conner and Gerald V. Foster. December 19, 1947. 12p. diagrs. (NACA RM L7J03)

Pressure distributions over an extended leading-edge flap, mounted on a 42° sweptback wing and deflected 50°, are presented for several angles of attack. Results indicate that the flap normal-force coefficient increased almost linearly with angle of attack to a maximum value of 3.25. Peak negative pressures built up at the flap leading edge with angle of attack and caused the chordwise location of the flap center of pressure to be moved forward. For the high angle-of-attack range, the center of pressure ranged between 49 and 55 percent of the flap chord.

NACA RM L7J10

PRELIMINARY TESTS TO DETERMINE THE MAXIMUM LIFT OF WINGS AT SUPERSONIC SPEEDS. James J. Gallagher and James N. Mueller. December 11, 1947. 41p. diagrs., photos., 3 tabs. (NACA RM L7J10)

Contains a variety of wing plan forms of random thickness distribution which were tested at Mach numbers of 1.55, 1.90, and 2.32 at angles of attack ranging from zero up through the angle at which maximum lift occurred. In general, at these Mach numbers the value of maximum lift coefficient was approximately 1.05 ± 0.05; it appeared to be independent of plan form and decreased slightly with increasing Mach number. No discontinuitles in lift occurred from zero angle of attack through maximum lift, which was attained at approximately 40° angle of attack. Lift-drag ratios at maximum lift were of the order of 1.0.

NACA RM L7K13

WIND-TUNNEL INVESTIGATION OF THE LOW-SPEED STABILITY AND CONTROL CHARACTERISTICS OF A MODEL WITH A SWEPTBACK VEE TAIL AND A SWEPTBACK WING. Edward C. Polhamus. May 25, 1948. 31p. diagrs. (NACA RM L7K13)

Tests were made in the Langley 300-mph 7- by 10-foot tunnel of a complete model with a sweptback vee tail and a sweptback wing to determine its low-speed stability and control characteristics. Tests were also made of the wing alone and of the wing in combination with the fuselage. Comparisons are made with the results of tests of the same tail panel with zero dihedral (horizontal tail) on the same wing-fuselage combination.

NACA RM L8B13

MEASUREMENT THROUGH THE SPEED OF SOUND OF STATIC PRESSURES ON THE REAR OF UNSWEPT AND SWEPTBACK CIRCULAR CYLINDERS AND ON THE REAR AND SIDES OF A WEDGE BY THE NACA WING-FLOW METHOD. Richard H. Sawyer and Fred L. Daum. July 21, 1948. 13p. diagrs., photos. (NACA RM L8B13)

Static-pressure measurements were made through the speed of sound by the NACA wing-flow method at the rear of two unswept circular cylinders of different length-diameter ratio and one 45° sweptback circular cylinder. Additional measurements were made at the rear and sides of a wedge. A Mach number range from about 0.7 to about 1.2 was covered in the tests.

NACA RM L8D23

TESTS OF THE NACA 64_1-012 AND 64_1A012 AIRFOILS AT HIGH SUBSONIC MACH NUMBERS. W. F. Lindsey and Milton D. Humphreys. July 9, 1948. 19p. diagrs., tab. (NACA RM L8D23)

An investigation of NACA 64_1-012 and 64_1A012 airfoils at Mach numbers between 0.35 and 0.89 and at low Reynolds numbers showed the effect of increasing the trailing-edge angle from 9° (NACA 64_1-012) to 14° (NACA 64_1A012).

NACA RM L8H25

STATIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A 52° SWEPTBACK WING OF ASPECT RATIO 2.88 AT REYNOLDS NUMBERS FROM 2,000,000 TO 11,000,000. James E. Fitzpatrick and Gerald V. Foster. November 16, 1948. 21p. diagrs., photo. (NACA RM L8H25)

Presents results of test of a 52° sweptback wing with aspect ratio of 2.88, taper ratio 0.625, and NACA 64_1-112 airfoil sections perpendicular to the 0.282-chord line for Reynolds number range of 2,000,000 to 11,000,000. Tests were made with and without half-span split flaps for both the smooth and rough conditions. The tests also included a study of the flow changes at moderate to high lift coefficients.

NACA RM L8H25a

STATIC TESTS OF FOUR TWO-BLADE NACA PROPELLERS DIFFERING IN CAMBER AND SOLIDITY. Robert J. Platt, Jr. December 2, 1948. 23p. diagrs., photo. (NACA RM L8H25a)

Contains static-test data on two-blade propellers of the NACA 4-(3)(08)-03, 4-(5)(08)-03, 4-(10)(08)-03, and 4-(3)(08)-045 designs at blade angles from 0° to 40°. Some earlier data are included which were obtained with the propellers fluttering.

NACA RM L8H30

INVESTIGATION OF THE EFFECT OF SWEEP ON THE FLUTTER OF CANTILEVER WINGS. J. G. Barmby, H. J. Cunningham and I. E. Garrick. November 15, 1948. 70p. diagrs., photo., 7 tabs. (NACA RM L8H30. Now issued as TN 2121; Rept. 1014)

An experimental and analytical investigation of the flutter of uniform, cantilever, sweptback wings is reported. The experiments employed groups of wings swept back by rotating and by shearing. The angle of sweep ranged from 0° to 60° and the Mach numbers extended to approximately 0.9. Comparison with experiment indicates that the analysis developed in the present paper is satisfactory for nearly uniform cantilever wings of moderate length-to-chord ratios.

NACA RM L8I17

A METHOD FOR CALCULATING FLOW FIELDS OF COWLINGS WITH KNOWN SURFACE-PRESSURE DISTRIBUTIONS. Robert W. Boswinkle, Jr. November 22, 1948. 23p. diagrs. (NACA RM L8I17)

Describes a way in which the data of three previous papers may be utilized to compute the incompressible flow fields of cowling-spinner combinations and open-nose inlets at zero incidence. The method consists of regarding the cowling surface as replaced by a ring vortex sheet whose strength at any point is equal to the local tangential velocity. The field of the ring vortex sheet is integrated to give the induced velocities of the body. An approximate method is given for cowlings at angles of attack. A comparison of calculated points with experimental data indicates that the method gives adequate accuracy for propeller design purposes. The application of the Prandtl-Glauert rule for compressible flow is given in detail.

NACA RM L8I24

SURFACE-PRESSURE DISTRIBUTIONS ON A SYSTEMATIC GROUP OF NACA 1-SERIES COWLINGS WITH AND WITHOUT SPINNERS. Robert W. Boswinkle, Jr. and Arvid L. Keith, Jr. November 30, 1948. 188p. diagrs., 3 tabs. (NACA RM L8I24)

Presents the static-pressure distributions on the tops of 79 NACA 1-series cowling-spinner combinations and 9 NACA 1-series open-nose cowlings over wide ranges of inlet-velocity ratio at angles of attack of 0°, 2°, 4°, and 6° for use in calculating the flow fields of such cowlings. This flow field information is useful in the design of propellers. Some effects of changes in the internal lip shape and of propeller operation on the surface pressures on the cowlings are shown.

NACA RM L8J01

INVESTIGATION OF HORN BALANCES ON A 45° SWEPTBACK HORIZONTAL TAIL SURFACE AT HIGH SUBSONIC SPEEDS. Harold S. Johnson and Robert F. Thompson. December 3, 1948. 63p. diagrs., photo., 2 tabs. (NACA RM L8J01)

A wind-tunnel investigation of horn balances on a 45° sweptback, semispan, horizontal tail surface was made to determine the effects of horn size and inboard-edge fairing at a Mach number of 0.30 and to determine the effects of compressibility up to a Mach number of 0.89. Presented are lift, drag, pitching-moment, and hinge-moment data and lift and hinge-moment parameters.

NACA RM L8K19

WIND-TUNNEL INVESTIGATION AT LOW SPEEDS OF VARIOUS PLUG-AILERON AND LIFT-FLAP CONFIGURATIONS ON A 42° SWEPTBACK SEMISPAN WING. Leslie E. Schneiter and James M. Watson. January 26, 1949. 45p. diagrs., photos. (NACA RM L8K19)

Contains results and discussion of a high-lift and lateral-control investigation at low speed on a 42° sweptback semispan-wing model. The lift characteristics of a full-span slotted flap at various deflections and positions of the flap nose, a partial-span slotted flap, and a partial-span Zap flap were determined in addition to a determination of the lateral-control characteristics of a plug-aileron configuration and various modifications thereof, and the characteristics of a partial-span plain aileron in both the flap-retracted and flap-deflected configurations.

NACA RM L8L06

AN INVESTIGATION OF THE CHARACTERISTICS OF THREE NACA 1-SERIES NOSE INLETS AT SUBCRITICAL AND SUPERCRITICAL MACH NUMBERS. Robert E. Pendley and Norman F. Smith. January 13, 1949. 38p. diagrs., photo. (NACA RM L8L06)

Results of measurements of pressure distribution and drag are presented for NACA 1-65-050, NACA 1-50-100, and NACA 1-40-200 nose inlets. Data were obtained at two fineness ratios and at Mach numbers up to 0.925 for a range of inlet-velocity ratio. An appreciable margin was measured between the critical Mach number and the Mach number at which a drag rise occurred. A sharp pressure peak raised at the inlet lip at low inlet-velocity ratios did not affect the Mach number for drag rise.

NACA RM L9A07

LOW-SPEED INVESTIGATION OF AILERON AND SPOILER CHARACTERISTICS OF A WING HAVING 42° SWEEPBACK OF THE LEADING EDGE AND CIRCULAR-ARC AIRFOIL SECTIONS AT REYNOLDS NUMBERS OF APPROXIMATELY 6.0×10^6. Stanley H. Spooner and Robert L. Woods. March 10, 1949. 58p. diagrs., photos. (NACA RM L9A07)

The lateral characteristics of an aileron and several spoiler arrangements on a 42° sweptback wing with symmetrical circular-arc airfoil sections and various high-lift and stall-control devices are shown. Includes aileron normal-force, hinge-moment, and balance-chamber pressure coefficients. The Reynolds number of the tests, which were conducted in the Langley 19-foot pressure tunnel, varied from 5.3×10^6 to 6.9×10^6 which corresponded to a Mach number range of 0.11 to 0.15.

NACA RM L9A18

PRESSURE-DISTRIBUTION MEASUREMENTS OVER AN EXTENSIBLE LEADING-EDGE FLAP ON TWO WINGS HAVING LEADING-EDGE SWEEP OF 42° AND 52°. Reino J. Salmi. March 7, 1949. 36p. diagrs., photos. (NACA RM L9A18)

Contains results of pressure-distribution measurements over a leading-edge flap on two wings having leading-edge sweep of 42° and 52° with NACA 64_1-112 sections. The 42° sweptback wing was of aspect ratio 4.01, taper ratio 0.625, equipped with half-span split flaps and was tested in combination with a circular fuselage at a Reynolds number of 5.12×10^6 and Mach number of 0.11. The 52° sweptback wing was of aspect ratio 2.88, taper ratio 0.625, equipped with half-span split flaps and a fence. The tests were made at a Reynolds number of 4.4×10^6 and Mach number of 0.08, and at various angles of yaw.

NACA RM L9F10

PRELIMINARY AERODYNAMIC INVESTIGATION OF THE EFFECT OF CAMBER ON A 60° DELTA WING WITH ROUND AND BEVELED LEADING EDGES. John M. Riebe and Joseph E. Fikes. August 16, 1949. 46p. diagrs., photos., tab. (NACA RM L9F10)

Contains the results of an investigation in the Langley 300-mph 7- by 10-foot wind tunnel to determine the effect of camber on lift-drag ratio and the longitudinal and lateral stability characteristics on a 60° delta wing at Reynolds numbers of 1.5×10^6 and 3.0×10^6. Angles of attack ranged from 0° to 40°; angles of yaw ranged from -4° to 20°. Camber was produced by full-span leading-edge flaps of round and beveled shapes deflected through a range of 0° to 60°.

NACA RM L9H09

PERFORMANCE CHARACTERISTICS OF TWO 6° AND TWO 12° DIFFUSERS AT HIGH FLOW RATES. William J. Nelson and Eileen G. Popp. October 19, 1949. 26p. diagrs. (NACA RM L9H09)

The aerodynamic characteristics of two circular-inlet and two annular-inlet diffusers of fixed area ratio (1.75) have been determined at inlet Mach numbers from 0.2 to the choked condition. The pressure-loss coefficient and diffuser effectiveness of each of these diffusers is shown to be essentially independent of Reynolds number in the subcritical-flow range; the performance falls off rapidly when sonic velocity is exceeded at any point in the system. Pressure distributions across both the inlet and exit and along the diffuser walls are presented. Inlet-boundary-layer profiles were also measured.

NACA RM L9H23

AN INVESTIGATION OF THE CHARACTERISTICS OF AN UNSWEPT WING OF ASPECT RATIO 4.01 IN THE LANGLEY 8-FOOT HIGH-SPEED TUNNEL. Ralph P. Bielat and Maurice S. Cahn. November 8, 1949. 32p. diagrs., 2 tabs. (NACA RM L9H23)

An investigation of the characteristics of a wing of aspect ratio 4.01 was conducted at high subsonic Mach numbers in the Langley 8-foot high-speed tunnel. The results of this investigation indicate that the severe changes in aerodynamic characteristics usually associated with wings of average or high aspect ratio were alleviated and were delayed to higher Mach numbers.

NACA RM L9J03

SURVEY OF TWO-DIMENSIONAL DATA ON PITCHING-MOMENT CHANGES NEAR MAXIMUM LIFT CAUSED BY DEFLECTION OF HIGH-LIFT DEVICES. Jerold M. Bidwell and Jones F. Cahill. December 2, 1949. 13p. diagrs., tab. (NACA RM L9J03)

The large pitching-moment increments associated with deflection of certain types of trailing-edge high-lift devices have made it difficult or impossible to obtain trim during landing and take-off. As an aid in the selection of high-lift devices, therefore, a survey has been made of two-dimensional data on the changes in pitching moment resulting from deflection at various types of high-lift devices. The types of high-lift devices investigated include extensible and nonextensible leading-edge and trailing-edge flaps and slats.

NACA RM E6J21

EXPERIMENTAL INVESTIGATION OF THRUST AUGMENTATION OF A TURBOJET ENGINE AT ZERO RAM BY MEANS OF TAIL-PIPE BURNING. Bruce T. Lundin, Harry W. Dowman and David S. Gabriel. January 6, 1947. 34p. diagrs., photos., tab. (NACA RM E6J21)

The performance of a turbojet engine equipped with a tailpipe burner designed by the NACA has been investigated at zero ram over a range of rotor speeds and tailpipe-burner fuel flows. The burner consisted essentially of an enlarged tailpipe incorporating fuel-spray nozzles and a flame holder. An adjustable-area exhaust nozzle is installed at the burner discharge.

THE FOLLOWING REPORTS HAVE BEEN DECLASSIFIED FROM CONFIDENTIAL TO UNCLASSIFIED, 1/8/54.

NACA RM A8A20

AN INVESTIGATION OF SUBMERGED AIR INLETS ON A 1/4-SCALE MODEL OF A TYPICAL FIGHTER-TYPE AIRPLANE. Noel K. Delany. June 2, 1948. 47p. diagrs., photos. (NACA RM A8A20)

Results are presented for ramp plan forms with parallel and with diverging walls and show the effect of the duct-entrance location (forward of the wing and over the wing), internal ducting efficiency, and deflectors. The air inlets having the ramps with diverging walls were satisfactory in both locations tested on the fuselage. The submerged air inlets with parallel ramp walls had lower ram pressure recoveries for the normal operating range. The ram pressure-recovery ratios measured at the inlets were higher for the forward location of the inlets than for the aft location.

NACA RM E7H27

INDIRECT METHODS FOR OBTAINING RAM-JET EXHAUST-GAS TEMPERATURE APPLIED TO FUEL-METERING CONTROL. Eugene Perchonok, William H. Sterbentz and Stanley H. Moore. January 14, 1948. 36p. diagrs. (NACA RM E7H27)

Presents development and experimental verification of analytical method that gives two independent means of obtaining total-temperature ratio across a ram jet or turbojet tail-pipe burner without direct measurement of final gas temperature. Proposes several total-temperature-ratio meter designs, which provide simple means of evaluating total-temperature ratio and also provide basis for ram-jet fuel-metering controls using total-temperature ratio as control variable.

NACA RM E8D30

VIBRATION SURVEY OF NACA 24-INCH SUPERSONIC AXIAL-FLOW COMPRESSOR. André J. Meyer, Jr. and Morgan P. Hanson. July 30, 1948. 45p. diagrs., photos. (NACA RM E8D30)

Vibration investigations were made of two blade cascades in wind tunnels and of blades operated in the NACA 24-inch supersonic compressor. The results showed that the blade vibrations were present at all tunnel and compressor air velocities and were influenced primarily by tunnel design, simulated centrifugal loading, surging angle of attack, and possible critical Mach numbers.

NACA RM E50I29a

INTERPRETATION OF BOUNDARY-LAYER PRESSURE-RAKE DATA IN FLOW WITH A DETACHED SHOCK. Roger W. Luidens and Robert T. Madden. December 22, 1950. 14p. diagrs., photos. (NACA RM E50I29a)

A procedure is presented for determining boundary-layer quantities from pressure-rake data, which includes the combined effects of viscous and shock losses. The analysis utilizes schlieren photographs of the shock configuration, the continuity of mass relationship, and the characteristic of the turbulent boundary layer that its outer edge is defined by a rapid change in the slope of the Mach number profile.

NACA RM L7A08

EFFECT OF NUMBER OF FINS ON THE DRAG OF A POINTED BODY OF REVOLUTION AT LOW SUPERSONIC VELOCITIES. N. Mastrocola. April 7, 1947. 10p. diagrs., photos. (NACA RM L7A08)

The interference drag increased with increased number of fins up to a Mach number of 1.35; above this value the effect is reversed. The magnitude of interference effects, for the bluff fin sections used in these tests, is such as to make these effects important in estimating the drag of a multifin tail group. The fin drag was found to be comparatively large and was attributed to the blunt leading edge and square trailing edge of the fin airfoil section.

The test data from flight tests of three- and five-fin bodies up to a Mach number of approximately 1.4 are given.

NACA RM L7B20

COMPARATIVE DRAG MEASUREMENTS AT TRANSONIC SPEEDS OF 6-PERCENT-THICK AIRFOILS OF SYMMETRICAL DOUBLE-WEDGE AND CIRCULAR-ARC SECTIONS FROM TESTS BY THE NACA WING-FLOW METHOD. Norman S. Silsby. April 8, 1947. 10p. diagrs. (NACA RM L7B20)

Both airfoils had a thickness of 6 percent of the chord, were of rectangular plan form, and had an aspect ratio of 4.0. The tests were run at M = 0.65 to 1.10. The results indicated that the principal difference in the drag characteristics of the two airfoils at zero lift is the earlier drag rise of the double-wedge section. Although the double-wedge airfoil had a somewhat higher drag throughout the Mach number range tested, the difference decreased with increasing Mach number after the onset of the drag rise of the circular-arc section, and at M = 1.10 the drag coefficient for the two airfoils was about the same.

NACA RM L7C05

DRAG CHARACTERISTICS OF RECTANGULAR AND SWEPT-BACK NACA 65-009 AIRFOILS HAVING VARIOUS ASPECT RATIOS AS DETERMINED BY FLIGHT TESTS AT SUPERSONIC SPEEDS. Warren A. Tucker and Robert L. Nelson. April 22, 1947. 15p. diagrs., photos. (NACA RM L7C05)

Wings of aspect ratios 3.8 to 5.0 were used at Mach numbers 1.0 to 1.3. The drag coefficient decreased as the sweepback angle increased, the rate of decrease being somewhat greater for the larger aspect ratios. For Mach numbers greater than a value somewhat less than that at which the Mach line lies along the leading edge, the drag coefficient decreased with a decrease in aspect ratio.

NACA RM L7K12

PRESSURE DISTRIBUTION OVER A SHARP-NOSE BODY OF REVOLUTION AT TRANSONIC SPEEDS BY THE NACA WING-FLOW METHOD. Edward C. B. Danforth and J. Ford Johnston. March 5, 1948. 25p. diagrs., photos. (NACA RM L7K12)

Contains pressure distributions by the NACA wing-flow method at Mach numbers between 0.70 and 1.05, over a sting-mounted body of revolution of circular-arc profile and fineness ratio 6. The measurements are compared with existing subsonic and supersonic theory where applicable. The manner in which transition occurs from the subsonic to the supersonic type of pressure distribution is shown with particular reference to the accompanying rapid increases in pressure drag.

NACA RM L8F23

A LIMIT PRESSURE COEFFICIENT AND AN ESTIMATION OF LIMIT FORCES ON AIRFOILS AT SUPERSONIC SPEEDS. John P. Mayer. August 23, 1948. 18p. diagrs. (NACA RM L8F23)

The results of an estimation of the limit forces on airfoils at supersonic speeds are presented. Computed values of the forces on two-dimensional wings are in good agreement with three-dimensional wind-tunnel data at high angles of attack where detached shock waves are present. A limit pressure coefficient attainable on an airfoil is given as based on experimental data. The empirical limit pressure coefficient corresponds to about 70 percent of the pressure coefficient for a vacuum.

NACA RM L8H06

PRESSURE DISTRIBUTIONS OVER A WING-FUSELAGE MODEL AT MACH NUMBERS OF 0.4 TO 0.99 AND AT 1.2. Clarence W. Matthews. November 3, 1948. 24p. diagrs. (NACA RM L8H06)

Pressure coefficients and Mach numbers are presented for the flow over a prolate spheroid and an NACA 65-010 wing section in the transonic Mach number range. The values over the prolate spheroid are compared with theoretical values. A study is made of the development of a supersonic flow pattern. Tunnel-wall-constriction effects at Mach numbers near unity are also considered.

NACA RM L8H31a

EFFECT OF STRUT-MOUNTED WING TANKS ON THE DRAG OF NACA RM-2 TEST VEHICLES IN FLIGHT AT TRANSONIC SPEEDS. Sidney R. Alexander. November 18, 1948. 13p. diagrs., photos. (NACA RM L8H31a)

Results of a free-flight investigation near zero lift of an NACA RM-2 drag research model equipped with strut-mounted wing tanks of fineness ratio 7.44 are presented for a Mach number range from about 0.7 to 1.1. The addition of the tanks and struts caused the drag rise to occur at a lower Mach number and produced a drag-coefficient increment of 0.075 at a Mach number of 0.72 which increased to 0.82 (the maximum increment obtained) at a Mach number of 1.06. Estimation indicates that the proximity of the struts and tanks may produce significant trim changes in the Mach number range investigated.

NACA RM L8L07a

FLIGHT INVESTIGATIONS AT LOW SUPERSONIC SPEEDS TO DETERMINE THE EFFECTIVENESS OF CONES AND A WEDGE IN REDUCING THE DRAG OF ROUND-NOSE BODIES AND AIRFOILS. Sidney R. Alexander. March 3, 1949. 15p. diagrs., photos. (NACA RM L8L07a)

It is clearly indicated from results and tests conducted at low supersonic speeds that a small cone placed ahead of a round-nose body can effectively reduce the drag of the basic body. The presence of a small wedge placed ahead of a round-nose airfoil did not appreciably affect the drag of the basic airfoil in the investigated Mach number range of M = 1.05 to 1.225.

NACA RM L9A12

AERODYNAMIC CHARACTERISTICS OF A 6-PERCENT-THICK SYMMETRICAL DOUBLE-WEDGE AIRFOIL AT TRANSONIC SPEEDS FROM TESTS BY THE NACA WING-FLOW METHOD. Lindsay J. Lina. March 4, 1949. 27p. diagrs. (NACA RM L9A12)

Tests were made in the transonic speed range by the NACA wing-flow method to investigate the lift, pitching-moment, and drag characteristics of a 6-percent-thick-chord symmetrical double-wedge airfoil having a rectangular plan form of aspect ratio 4.0. The tests covered a range of Mach numbers from 0.66 to 1.12.

NACA RM L9B17

EXPERIMENTAL DETERMINATION OF THE SUBSONIC PERFORMANCE OF A RAM-JET UNIT CONTAINING THIN-PLATE BURNERS. John R. Henry. June 29, 1949. 54p. diagrs., photos. (NACA RM L9B17)

A ram-jet unit containing a cluster of thin-plate burners in a semicircular combustion chamber was tested in Langley induction aerodynamics laboratory. Data were taken over a fuel-air-ratio range from 0 to 0.049, at combustion-chamber inlet velocities from 40 to 195 feet per second, and at simulated free-stream Mach numbers from 0.20 to 0.55. Combustion efficiencies from 56 to 72 percent were obtained. Combustion-chamber characteristics led to the conclusion that high-thrust-output operation would not be feasible. Thrust-coefficient estimates for supersonic flight are regarded as too low to be practical. Diffuser efficiencies of 99 percent were obtained.

NACA RM L9F02

FLIGHT INVESTIGATION AT HIGH-SUBSONIC, TRANSONIC, AND SUPERSONIC SPEEDS TO DETERMINE ZERO-LIFT DRAG OF BODIES OF REVOLUTION HAVING FINENESS RATIO OF 6.04 AND VARYING POSITIONS OF MAXIMUM DIAMETER. Ellis R. Katz. August 31, 1949. 17p. diagrs., photo. (NACA RM L9F02)

Flight investigation of rocket-powered models was performed at high-subsonic, transonic, and supersonic speeds to determine the zero-lift drag of fin-stabilized bodies of revolution differing only in position of maximum diameter. The bodies were of 6.04 fineness ratio and had cut-off sterns with equal base area for all models.

NACA RM L9H08

AN EMPIRICAL METHOD FOR ESTIMATING TRAILING-EDGE LOADS AT TRANSONIC SPEEDS. T. H. Skopinski. October 6, 1949. 43p. diagrs., tab. (NACA RM L9H08)

An empirical method for estimating trailing-edge loads and moments in the transonic region is presented. A comparison of the experimental trailing-edge normal-force and bending-moment coefficients obtained for 15 different NACA airfoil sections with those calculated by the proposed empirical method indicated that the method may be used as a guide when specific applicable experimental data are not available at the design stage.

NACA RM L9J11

PRELIMINARY INVESTIGATION OF A VARIABLE MASS-FLOW SUPERSONIC NOSE INLET. Clyde Hayes. December 13, 1949. 15p. diagrs., photos. (NACA RM L9J11)

A method employing an inflatable boot on the central-body surface has been analyzed for varying the mass flow of supersonic inlets having a circular cross section and a central body. The tests made at a Mach number of 2.70 show effects of such a method on the entering flow, mass flow, and pressure recovery.

NACA RM L52E29a

PRELIMINARY INVESTIGATION OF THE EFFECTS OF HEAT TRANSFER ON BOUNDARY-LAYER TRANSITION ON A PARABOLIC BODY OF REVOLUTION (NACA RM-10) AT A MACH NUMBER OF 1.61. K. R. Czarnecki and Archibald R. Sinclair. July 1952. 23p. diagrs., photos., tab. (NACA RM L52E29a)

This paper presents the results of a preliminary investigation of the effects of heat transfer on boundary-layer transition on a parabolic body of revolution (NACA RM-10) at Mach number of 1.61. This paper includes also a study of the effectiveness of cooling on boundary-layer transition with model surface roughened and a comparison of the results obtained in this investigation with other available theoretical and experimental data.

NACA RM L53B25

AN EXTENSION OF THE INVESTIGATION OF THE EFFECTS OF HEAT TRANSFER ON BOUNDARY-LAYER TRANSITION ON A PARABOLIC BODY OF REVOLUTION (NACA RM-10) AT A MACH NUMBER OF 1.61. K. R. Czarnecki and Archibald R. Sinclair. March 1953. 21p. diagrs., photo. (NACA RM L53B25)

This paper covers the extension of a previous investigation of the effects of heat transfer on boundary-layer transition to higher Reynolds numbers, to greater amounts of heating, and to a more extensive study of the effects of surface roughness and wind-tunnel flow disturbances. The tests were made at a Mach number of 1.6 and over a Reynolds number range from 2.5×10^6 to 35×10^6. A comparison is made between the experimental results and theory.

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